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BIRD-BANDING

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BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. IX JANUARY, 1938 No. 1

THE BIOLOGICAL SIGNIFICANCE OF BIRD WEIGHTS[1]

By MARGARET MORSE NICE

THE recording of the weights of birds has two chief values: first, we need to know the average weight of a species just as much as its length; second, there are many biological problems on which weights of birds will throw light. How does the same species vary in weight from one locality to another? How does weight fluctuate throughout the year? Throughout the day? According to sex, age, and stage of the nesting cycle? How much individual variation is there when other factors are similar? Finally, to enter the realm of experiment, how much do birds eat in relation to their weight?

Some banders are faithful in weighing their birds. In this country two lists of large numbers of individuals of different species have been published, one for New England (Wetherbee), the other for northern Ohio (Stewart). Several lists have appeared giving for the most part single weights of a number of species (Broun, Esten, Grinnell, Wetmore, Whittle), while in a few instances single species have been treated somewhat at length (Linsdale and Sumner, '34a, '34b, '37, Nice, '37, Partin, Snyder). Weights of many species are given in Roberts's "Birds of Minnesota." An important contribution is that of Heinroth's in which weights are given for 436 species from all over the world (see Huxley for a reworking of this data in English).

The purpose of the present paper is twofold. First of all, it is a plea to banders to *weigh their birds at every capture*. Secondarily, it is hoped to encourage those who have data on the subject to analyze their records and get the greatest value possible from them.

The total of my own records is not large—some 1400 weights on 30 species, yet they have yielded important data, especially in those cases where representative numbers were obtained. All of the weights were taken in Columbus, Ohio, from the fall of 1931 to the spring of 1936.

Each bird was placed in a cloth bag and weighed on scales sensitive to one-tenth of a gram. The weight of the bag fluctuated with atmospheric conditions and had to be determined each day. The wing and tail of each bird was measured by means of dividers, and it was found that with a number of species, particularly the native sparrows, the majority of individuals fell into two size-classes, and

[1] Read at the Charleston meeting of the American Ornithologists' Union, November, 1937.

with Ridgway as a guide, the larger birds were recorded as males, the smaller as females, using the wing measurement as the basis. With Song Sparrows I was able to check my judgment on 260 breeding birds, all of which were color-banded. One hundred and twenty-one of the males had wing measurements between 65 and 69 mm., 102 of the females between 58 and 63 mm. Eight males and seventeen females had wings measuring 64 mm., while four males fell into the female range with wings of 62 and 63 mm., and four females into the male range with wings of 65 and 66 mm. Thus nine per cent of all the birds were intermediate in measurements, while three per cent overlapped.

As to the Chickadees, most of the weights are on a pair of color-banded birds; the male, besides being slightly larger, was seen to feed his mate. During the nesting season, the presence or absence of the incubation patch is an indication of sex in some species.

The data obtained on seasonal and daily fluctuation in weight are summarized in Table I. Many of the species are classified by sex, but totals are also given, so the results are comparable with those of other observers.

In the last column the percentage of increase is given of the average of the weights taken from 3:00 to 6:00 P.M. over those from 6:00 to 8:00 A.M. In the seven species in which sufficient data were obtained, the increases range from 4.6 per cent in the Song Sparrow to 10.8 per cent in the Junco. Other investigators have reported the following average daily increases: Partin with the House Finch (*Carpodacus mexicanus frontalis*) 3.5 per cent; Linsdale and Sumner, ('34a), with the Golden-crowned Sparrow (*Zonotrichia coronata*), 3.9 per cent; and Stewart with the Eastern Goldfinch (*Spinus t. tristis*), 8.4 per cent. With 45 weighings on two captive male Western Mourning Doves (*Zenaidura macroura marginella*) in Oklahoma I found ('17, '29) an average daily increase of 8.6 per cent. Stewart states that "The ratio diminishes as the size of the bird increases," but this does not seem to be borne out within the limits of weight of the above birds—12 to 100 grams.

SEASONAL FLUCTUATIONS

It will be noted in the table that as a rule spring weights are higher than fall weights and winter weights the highest of all.

Fall Weight. There is no evidence in the birds which I captured of high weight in the fall in connection with migration.

Do transients that remain for one to three weeks gain weight? It was only with White-throated Sparrows that I obtained data on this problem, and only in the fall of 1931, which happened to be unusually mild. Five males and eight females repeated from 5 to 26 days after the first capture, the average stay of the males being 16 days and the females 12 days. (Most of the weights were taken in the early morning; in cases where comparison had to be made between one of these and a weight taken later in the day, 8 per cent

was deducted from the latter.) Seven birds that stayed from 5 to 22 days showed an average loss of 0.7 of a gram, 5 birds that stayed from 6 to 26 days showed an average gain of 0.9 of a gram, while one bird that stayed 12 days gained 5.3 grams or 24 per cent of her original weight. From these figures it is clear that with one exception there was no gain in weight in White-throated Sparrows that stopped in Columbus on their fall migration.

Kendeigh reports that in northern Ohio in the fall the later migrants of White-crowned and White-throated Sparrows are heavier than the earlier, while the reverse is true in the spring. Similar results were found by me with White-throats in the fall of 1931. Twenty-five males in the first half of the migration averaged 25.9 grams, and 19 in the second half 26.5; 32 females in the first half averaged 23.8 grams, and 19 in the second half 25.2 grams.

Rather unexpectedly a difference in the weights of the White-throats was shown in two succeeding fall seasons as follows:

1931. 44 males ranged from 23.2–28.9, averaging 26.2 grams. (Sept. 26 to Nov. 8)
1932. 6 males ranged from 27.5–30.8, averaging 29.2 grams. (Oct. 7 to 14)
1931. 51 females ranged from 21.0–27.8, averaging 24.1 grams. (Sept. 26 to Oct. 26)
1932. 24 females ranged from 22.3–29.2, averaging 26.0 grams. (Oct. 5 to Nov. 8)

The average in 1931 of the 95 birds of both sexes was 25.0 grams, of the 30 in 1932, 26.6 grams—a 6 per cent increase. If the 19 birds captured in 1931 before October 6 are omitted, the 37 males weighed 26.1 grams and the 39 females 24.3 grams, the 76 averaging 25.2 grams, a gain of 5.5 per cent. In an attempt to check this matter of greater weight in 1932 than 1931, I found it was only with Song Sparrows that I had sufficient data for comparison: in October and November, 1931, 65 birds of both sexes averaged 21.4 grams in weight, while in 1932, 40 averaged 21.9 grams, an increase of 2 per cent.

In 1931, in Columbus, October averaged 3°F. above normal, while in 1932 it averaged 0.6° below normal, the first half averaging 4° below normal. Linsdale and Sumner ('34a) found an increased weight in Golden-crowned Sparrows in cool weather and a loss on hot days. I do not know that any data has been published on average weights during the fall migration in different years, but this is an interesting problem. The White-throats did not linger with us in 1932 as they had done the previous fall, the longest period of stay, according to captures, being 7 days.

Winter Weight. That many species respond to the cold of winter by putting on a coat of fat is shown by the preponderance of cases in which weight increases at this season.

The Song Sparrows on Interpont gained weight in December, reaching their peak in January. Individual males sometimes gained

TABLE 1

SEASONAL AND DAILY FLUCTUATIONS IN WEIGHT OF TWENTY SPECIES
(All Weights in Grams)

Species	Total No.	Sex	Average	Fall			Winter			Spring			Summer			Daily Increase	
				No.	Range	Average	No.	Range	Average	No.	Range	Average	No.	Range	Average	No. Weights	Per-centage
E. Bob-white	12	♂	201.7	6	180.8–220.7	193.5	6	191.3–223.2	209.9								
Colinus v.	18	♀	200.4	10	166.3–228.3	193.6	8	184.6–217.5	209.0								
virginianus	30	Both	201.0	16		193.6	14		209.4								
Percentage						100%			103.5%								
E. Mourning Dove	2	♂								2	139.4–148.7	144.0					
Zenaidura	1	♀								1		140.0					
macroura marginella	3	Both	142.8														
N. Blue Jay																	
Cyanocitta c.	8	Both	86.9	3	89.4– 98.0	92.9	2	77.6– 90.2	80.4	3	79.4– 90.2	85.7					
cristata												92.2%					
Percentage						100%			86.5%								
Carolina Chickadee	8	♂	11.0	1		10.5	3	10.8– 12.0	11.2	4	10.4– 11.0	11.0					
Penthestes c.	9	♀	9.8	1		10.3	3	9.9– 10.2	10.1	5	9.0– 10.0	9.6					
carolinensis	17	Both	10.4	2		10.4	6		10.7	9		10.2					
Percentage						100%			103%			98%					
Tufted Titmouse																	
Baeolophus bicolor	36	Both	22.4	8	20.7– 25.3	22.2	21	20.3– 2.48	2.2	7	20.5– 23.8	22.4					
Percentage						100%			103%			98%				7	5.5%
Ohio House Wren																	
Troglodytes aedon baldwini	7	Both	11.1	2	11.0– 11.8	11.4				5	9.6– 12.1	11.0					
Percentage						100%						96.5%					
Carolina Wren																	
Thryothorus l. ludovicianus	6	Both	19.4	1		18.0	4	18.9– 20.5	19.8	1		19.6					
Percentage						100%			110%			109%					
Catbird																	
Dumetella carolinensis	13	Both	35.9							11	32.5– 41.7	36.1	2	32.0– 37.0	35.3		
E. Robin	16	♂	80.9				4	72.8– 97.1	83.9	12	68.8– 89.5	79.1					
Turdus m.	23	♀	81.2	2	79.2– 81.7	80.5				18	74.0– 96.0	82.3	3	71.0– 78.8	74.9		
migratorius	39	Both	81.1	2		80.5	4		83.9	30		81.3	3		74.9	23	8.1%
Percentage						100%			104.2%			101%			93%		

TABLE 1 CONTINUED ON NEXT PAGE

TABLE 1 CONTINUED ON NEXT PAGE

Hermit Thrush																		
Hylocichla guttata faxoni	2		30.8	1		29.9				6		31.7						
Starling	25	♂	82.2				25	73.3– 91.3	82.2									
Sturnus v.	6	♀	79.3				3	76.0– 84.0	80.7	3	77.2– 78.6	77.8						
vulgaris	31	Both	81.6				28		82.0	3	77.2– 78.6	77.8						
House Sparrow	24	Adult	28.5	18	25.8– 30.9	28.5				6	24.7– 30.8	28.5						
Passer d. domesticus	17	Im.	28.2	17	25.9– 30.7	28.2												
E. Cowbird	5	♂	50.7							5	48.2– 51.7	50.7						
Molothrus a. ater	14	♀	39.8							14	34.2– 45.6	39.8						
E. Cardinal	18	♂	44.5	2	42.3– 51.0	46.7	13	38.2– 48.6	44.4	2	43.7– 46.1	44.6	1		45.0			
Richmondena c.	24	♀	42.3	4	42.0– 45.8	44.1	17	34.5– 48.4	41.7	3	42.3– 46.2	42.8						
cardinalis	42	Both	43.4	6		45.0	30		42.9	5		44.1	1		45.0			
Percentage						100%			95.5%			98.2%			100%	16	9.6%	
Slate-colored Junco	124	♂	20.4	55	17.7– 22.0	19.7	48	17.4– 25.2	20.8	21	18.3– 25.2	20.6						
Junco h.	35	♀	19.4	20	16.8– 20.5	18.9	14	18.1– 23.1	20.1	1		18.6						
hyemalis	159	Both	20.2	75		19.5	62		20.7	22		20.5						
Percentage						100%			106%			105%				73	10.8%	
E. Tree Sparrow																		
Spizella a. arborea	12		18.4				7	16.5– 20.2	18.4	5	17.3– 20.8	18.4						
White-crowned Sparrow	16	♂	32.2	3	27.4– 31.1	29.3	8	30.5– 36.8	35.0	5	27.7– 32.8	31.5						
Zonotrichia l.	6	♀	27.1	5	25.1– 28.1	27.0				1		27.5						
leucophyrs	22	Both	30.8	8		28.0	8		35.0	6		30.8						
Percentage						100%			125%			110%				10	7.0%	
White-throated Sparrow	67	♂	27.2	50	23.2– 30.8	26.5				17	26.1– 35.0	29.4						
Zonotrichia	93	♀	25.0	75	21.0– 29.2	24.7				18	22.5– 32.5	26.4						
albicollis	160	Both	26.8	125		25.4				35		28.6						
Percentage						100%						113%				75	8.2%	
Lincoln Sparrow																		
Melospiza l. lincolni	8		18.3	5	16.2– 18.8	17.4				3	18.6– 21.0	19.8						
Miss. Song Sparrow	463	♂	23.0	88	18.8– 24.4	21.8	136	20.7– 30.0	24.2	231	19.2– 27.9	22.7	8	19.7– 23.6	21.4			
Melospiza melodia	283	♀	21.4	56	17.0– 24.3	20.6	46	18.9– 25.8	22.5	174	17.1– 26.0	21.5	7	17.6– 23.4	20.5			
euphonia	746	Both	22.4	144		21.4	182		23.8	405		22.2	15		21.0			
Percentage						100%			111%			104%			98%	327	4.6%	

as much as 25 to 44 per cent of their April weights. In Table I we see that the Song Sparrows averaged 11 per cent increase over the fall weight, and the Junco 6 per cent. In the case of the White-crown, where 25 per cent increase is shown, the winter weights were based on only two individuals, and more data would probably decrease this ratio. As to the Cardinal, I feel that the figures are not representative: the average of the six fall weights is too high owing to one exceptionally heavy male, and the winter average is too low owing to a predominance of early-morning weights and the repeating of several thin females. If only noon weights are considered, there was a gain in winter in both sexes: males—4 weights in fall and spring 43.6 grams, 6 in winter 45.3 grams (increase 3.9 per cent); females—5 in fall and spring 41.7 grams, 9 in winter 42.7 grams (increase 2.4 per cent). In the case of the Blue Jay, the data are too few for conclusions, only 8 weights and those taken on 7 individuals. The Bob-white winter weights were obtained in December. Stewart found a marked decrease in February with some of this species.

Increased weight in winter has been reported for many species: Starlings (*Sturnus v. vulgaris*) (Hicks); Fieldfares (*Turdus pilaris*) (Zedlitz); House Sparrows (Kendeigh); House Finches (Partin); Golden-crowned and Fox Sparrows (*Passerella iliaca*) (Linsdale and Sumner, '34b); Bramblings (*Fringilla montifringilla*) and Yellow Hammers (*Emberiza citrinella*) (Zedlitz). The single Ruby-crowned Kinglet (*Corthylio c. calendula*)—a male—captured by me December 7, 1932, at 10:00 A.M. weighed 8.1 grams, which is more than other records I can find: 6.5 grams in northern Ohio (Stewart), 5.8 grams October 1 on Cape Cod (Broun), 6.2, 6.4, 6.4 grams, October 11, Washington, D. C. (Wetmore).

On the other hand some birds show little change in winter—the Carolina Chickadee and Tufted Titmouse in the table, Northern Black-capped Chickadee (*Parus* (*Penthestes*) *atricapillus borealis*) and Marsh Titmouse in Sweden (*Parus p. palustris*) according to Zedlitz, and Chinese Tree Sparrow (*Passer montanus saturatus*) according to Shaw. All these birds sleep in cavities, and hence are not exposed to the cold as are birds roosting in the open. It would be interesting to know whether or not woodpeckers gain in winter. Zedlitz found no winter gain in Magpies but his data were few; figures from Hesse quoted by Linsdale, '37, appear to show an increase. Spotted Towhees (*Pipilo maculatus falcifer*) showed little change in weight from October to May in Berkeley, California, where they are permanent residents.

Weight in Spring and Summer. In Table I we find that in the five species of native sparrows the average spring weights range from 4 to 12.6 per cent above the average fall weights.

Higher weights in spring than in the fall were found with White-crowned and White-throated Sparrows by Kendeigh. As for winter-resident species, Heydweiller reports that the Eastern Tree Sparrow

attains its maximum weight "just preceding the spring departure during the first two weeks in March"; while Linsdale and Sumner, '34b, found, from 1422 weights of the Golden-crowned Sparrow, a peak in January and a much higher peak in May, and with the Fox Sparrow 711 weights showed similar peaks in December and May.

That the curve is different for the Song Sparrows in Columbus, Ohio, is shown by the averages of the winter and spring weights of the males (373 cases): December 23.8 grams, January 24.9 grams, February 24.1 grams, March 23.0 grams, April 22.4 grams, May and June 21.3 grams.

The Song Sparrows start the nesting season at a somewhat higher weight than they showed in fall. This probably remains about the same for the male from April on until after the young hatch, then the father loses about 9 per cent of his weight. As to the female, her weight suddenly rises—10 to 20 per cent—while she is laying eggs. This increased weight, due to the developing eggs, would seem to be the reason why some people record females weighing more than males during the breeding season. In Table I high weights of females in spring and summer are attributable to this cause in the case of the Catbird, Robin, Cowbird, and Song Sparrow. Ten weights of non-laying female Cowbirds average 38.7 grams, and 4 weights of laying females 42.7 grams.

There is some evidence that the female Song Sparrow gains a small amount of weight during incubation. Riddle and Braucher found an 8 per cent increase in pigeons and doves during incubation and attributed this gain to the inactivity of the birds.

While feeding young, the female Song Sparrow, like her mate, loses some 9 per cent of her weight. With the Tree Sparrow in Manitoba, Heydeweiller reported "almost 20 per cent [loss] for the males and 10 per cent for the females" when feeding young.

It will be seen that weights during the nesting season give a complicated picture, sometimes of high and sometimes of low weight.

As to the molt we should expect weight to be at its lowest point then, and the few data I have on Song Sparrows support this supposition. Beck found a heavy loss at this time with four domestic fowls. Laskey, however, reports the "highest weight during the inactive period of molting" in the case of male Mockingbirds (*Mimus p. polyglottos*) in Tennessee.

WEIGHT AND SEX

In many birds there is a decided size-difference between the sexes. This was true in only one of the species which I captured—the Cowbird—,the females averaging 76 per cent of the weight of the males. In the case of 204 Bronzed Grackles (*Quiscalus quiscula æneus*) killed in Ontario, March 26, 1930, the females averaged 77 per cent of the weight of the males (Snyder). In a series of 28 Yellow-billed Magpies (*Pica nuttalli*) the females averaged 83 per cent as heavy as the males, and in the same number of Black-billed

Magpies (*Pica p. hudsonia*) the females averaged "nearly 86 per cent as heavy as the males" (Linsdale, '37).

In four species of native Sparrows I found the females averaging the following percentages of the males' weights: Junco 95, White-crowned Sparrow (fall and spring) 88, White-throat, 92, and Song Sparrow 93.4. Female Fox Sparrows were found to average 98 per cent the weight of the males (Linsdale, '28) and female House Finches 99 per cent (Partin). These figures include breeding birds; mine do not, except for the Song Sparrows and Cowbirds.

WEIGHT AND AGE

In small passerines the immature birds often average slightly less in the fall than the adults. In seven species of Fringillidæ, Wetherbee found the immatures averaging from 2 to 8 per cent lighter than the adults. With the 10 weights of non-laying female Cowbirds in Columbus, the 3 weights of birds banded one or two years previously averaged 43 grams, while the 7 weights of new captures averaged 37.1 grams. Some of my old Song Sparrows were heavy, and others were not.

With various larger species there is much more difference with age: Starlings (Hicks), Crows (Hicks and Dambach, Zedlitz), Gallinaceous birds, Geese, etc.

WEIGHT AND LOCALITY

There is very little information on this interesting subject. Partin found evidence of differences in weight between House Finches in Los Angeles and Pasadena—a distance of only a few miles. There is very little data on the comparative weight of subspecies. From evidence at hand it would seem that the Eastern Mourning Dove is appreciably heavier than the western form; weights of the former from New England, Washington, D. C., and Ohio (3 males and 3 females) range from 138.4 to 152.7 grams and average 143 grams; weights of the latter from Oklahoma and California (3 males and 2 females) range from 102.5 to 121 grams, averaging 107.7 grams. Mr. John W. Aldrich of the Cleveland Museum of Natural History has kindly put at my disposal weights of 99 Horned Larks collected from December 5 to February 23. Weights of 24 male Northern Horned Larks (*Otocoris a. alpestris*) ranged from 42.0 to 51.4 grams, with a median of 44.8 grams; five females ranged from 35.0 to 43.5 grams with a median of 42.9 grams. Weights of 57 male Prairie Horned Larks (*O. a. praticola*) ranged from 28.5 to 44.7 grams, with a median of 37.5 grams; of 13 females from 31.6 to 36.9 grams with a median of 34.2.

WEIGHT AND INDIVIDUALITY

This is an almost untouched subject, but one that merits investigation. One of Linsdale's and Sumner's ('34a) Golden-crowned Sparrows was one-fourth heavier than the other male and 28 per cent heavier than the two females. With the breeding Song Spar-

rows the April weights for the males ranged between 19.6 and 24.2 grams.

PERCENTAGE OF FOOD EATEN IN RELATION TO WEIGHT

Experiments on the percentage of food eaten by birds in relation to their weight have been carried out in Europe and two main conclusions reached: the colder the weather, the greater the food consumption; the smaller the bird, the more—proportionately—does it eat.

A Masked Weaver (*Ploceus cucullatus abyssinicus*) weighing 40 grams ate 20 per cent of its weight daily at a temperature of 18°C. (65°F.), 25 per cent at 9°C. (48°F.), and 28 per cent at 7°C. (45°F.); a Red-billed Weaver (*Quelea quelea*) weighing 18 grams ate 28 per cent of its weight at 18°C., 30 per cent at 9°C., and 33 per cent at 7°C. (Schildmacher). Stevenson states that the average number of native sparrows trapped in the summer months at Gates Mills, Ohio, was 7.6 when the temperature was lower than 75°F. (23°C.), and only 3.7 when it rose above 80°F. (27°C.).

On the basis of night and early-morning weighings of 15 species ranging in size from warblers to Mourning Doves trapped in Illinois, Taber concluded that "the daily food consumption of wild birds averages approximately 15 or 16 per cent of their weight. This is true regardless of the size of the species." That he was mistaken in this last point is evident from Table II, where the inverse relation between size and relative food consumption is clearly shown. The smaller bird has a relatively larger surface than a large bird and hence loses more heat than the other.

TABLE II

PERCENTAGE OF FOOD EATEN IN RELATION TO WEIGHT OF BIRD

Species		*Weight of Bird*	*Food*	*Authority*
Falconiformes				
Common Buzzard	*Buteo buteo*	855–900	4.5 per cent	Rörig
Kestrel	*Falco tinnunculus*	200	7.7 per cent	Rörig
Galliformes				
Domestic Fowl	*Gallus domesticus*	1800	3.4 per cent[2]	Beck
Bob-white	*Colinus v. virginianus*	170	8.8 per cent[3]	Nice
Charadriiformes				
Lapwing	*Vanellus vanellus*	195	7.8 per cent[1]	Groebbels
Dunlin	*Calidris (Pelidna) alpina*	114	8.5 per cent[1]	Groebbels
Columbiformes				
Pigeon	?	516	5.4 per cent	Scharnke
Pigeon	?	360	6.5 per cent	Riddle
Dove	?	160	8.6 per cent	Riddle
W. Mourning Dove	*Zenaidura macroura marginella*	100	11.2 per cent[2]	Nice
Strigiformes				
Tawny Owl	*Strix aluco*	442–475	5.0 per cent	Rörig
Little Owl	*Athene noctua*	164–172	5.5 per cent	Rörig

Passeriformes				
Blackbird	*Turdus merula*	118	7.3 per cent[1]	Groebbels
Song Thrush	*Turdus philomelos*	89	9.8 per cent[1]	Groebbels
Redbreast	*Erithacus rubecula*	16	14.7 per cent[1]	Groebbels
Chaffinch	*Fringilla calebs*	22	13.2 per cent[2]	Groebbels
Goldfinch	*Carduelis carduelis*	13	17.5 per cent[2]	Groebbels
Great Titmouse	*Parus major*	18	26.0 per cent[1]	Rörig
Blue Titmouse	*Parus cæruleus*	11	30.0 per cent[1]	Rörig

[1] Dry weight, which was estimated as 40 per cent of the live weight of the mealworms fed.
[2] Seeds and grain.

SUMMARY

1. Weight was found to fluctuate from 4.6 to 10.8 per cent throughout the day.

2. As a rule spring weight exceeded fall weight, while winter weight was highest of all.

3. Weighings of White-throated Sparrows showed that in the mild fall of 1931 the birds averaged lighter than in the cold fall of 1932; that in 1931 birds that stayed from 5 to 26 days at Columbus failed to gain weight, and that later fall migrants were heavier than earlier migrants.

4. Many species gain weight in winter, but some do not.

5. Weight in the breeding season fluctuates considerably; the female increases markedly while laying eggs, and both parents lose weight while feeding young.

6. In many species the males are heavier than the females; in native sparrows captured in Columbus the female averaged from 88 to 95 per cent as heavy as the male, in Cowbirds 76 per cent.

7. Immature birds often weigh less than adults.

8. More food is eaten in cold weather than in warm.

9. Relatively more food is needed by a small bird than a large one.

REFERENCES

Beck, G. 1930. Neue Beiträge zur Zweikomponenttheorie des Hungers. *Ztsch. f. Psychologie*, 18:283–349.

Broun, M. 1933. Some Live Weights and Measurements of Small Birds. *Bird-Banding*, 4:52–54.

Esten, S. R. 1931. Bird Weights of 52 Species of Birds. *Auk*, 48:572–574.

Grinnell, J. 1923. Observations upon the Bird-Life of Death Valley. Calif. Acad. Sci. Proc. Ser. 4, 13 (5):43–109.

Groebbels, F. 1932. Der Vogel. I. Berlin. Borntraeger. 918p.

Heinroth, O. 1922. Die Beziehungen zwischen Vogelgewicht, Eigewicht, Gelegegewicht und Brutdauer. *Jour. f. Ornithologie*, 70:172–285.

Hesse, R. 1921. Das Herzgewicht der Wirbeltiere. *Zool. Jahrb. Abt. Allg. Zool. und Phys. der Tiere*, 33:243–364.

Heydweiller, A.M. 1935. A Comparison of Winter and Summer Territories and Seasonal Variations of the Tree Sparrow (*Spizella a. arborea*). *Bird-Banding*, 6:1–11.

Hicks, L. E. 1934. Individual and Sexual Variations in the European Starling. *Bird-Banding*, 5:103–118.

Hicks, L. E., and C. A. Dambach. 1935. Sex Ratios and Weights in Wintering Crows. *Bird-Banding*, 6:65–66.

Huxley, J. S. 1927. On the Relation between Egg-weight and Body-weight in Birds. *Jour. Linn. Soc., Zool.*, London, 36:457–466.

Kendeigh, S. C. 1934. The Rôle of Environment in the Life of Birds. *Ecological Monographs*, 4:299–417.

Laskey, A.R. 1937. Bird Banding Brevities No. 11. *Migrant*, 8:51–52.

Linsdale, J. M. 1928. Variations in the Fox Sparrow (*Passerella iliaca*) with Reference to Natural History and Osteology. Univ. Calif. Pub. Zool. 30:251–392.

1937. The Natural History of Magpies. Pacific Coast Avifauna, 25:1–234.

Linsdale, J. M., and E. L. Sumner, Sr. 1934a. Variability in weight in the Golden-crowned Sparrow. Univ. Calif. Pub. Zool., 40 (5):309–320.

1934b. Winter weights of Golden-crowned and Fox Sparrows. *Condor*, 36: 107–112.

1937. Weights of Spotted Towhees. *Condor*, 39:162–163.

Nice, M. M. 1917. Some Experiences with Mourning Doves in Captivity. *Proc. Oklahoma Acad. Sci.* 1:57–65.

1929. Some weights of Mourning Doves in Captivity. *Auk*, 46:233–234.

1932. Measurements of White-throated and Other Sparrows to Determine Sex. *Bird-Banding*, 3:30–31.

1937. Studies in the Life History of the Song Sparrow I. Trans. Linn. Soc. N. Y. 4:1–247.

Partin, J. L. 1933. A Year's Study of House Finch Weights. *Condor*, 35:60–63.

Riddle, O., and P. F. Braucher. 1934. Studies on the Physiology of Reproduction in Birds. XXXIII. *Am. Jour. Physiology*, 107:343–347.

Ridgway, R. 1901. Birds of North and Middle America. Bull. U. S. National Museum, 50. Part I:1–715.

Roberts, T. S. 1932. Birds of Minnesota. Minneapolis.

Rörig, G. 1905. Studien über die wirtschaftliche Bedeutung der insektenfressenden Vögel. *Biol. Abteil. Land- und Forstwirtschaft am Kaiserl. Gesundheits.*, 4:1–50.

Scharnke, H. 1932. Rythme nycthemeral et variations diurnes du metabolisme chez le pigeon et chez un hibou. *Ann. de Physiologie*, 8, (5):891–946.

Schildmacher, H. 1929. Ueber den Wärmehaushalt kleiner Körnerfresser. *Orn. Monatsber.*, 37:102–106.

Shaw, T. 1935. Variation in the Body Weight of the Tree Sparrow, *Passer montanus saturatus* Stejneger. *Bull. Fan Mem. Inst. Biol.* Peiping, 6:65–69.

Snyder, L. L. 1937. Some Measurements and Observations from Bronzed Grackles. *Canadian Field-Naturalist*, 51:37–39.

Stevenson, J. 1933. Experiments on the Digestion of Birds. *Wilson Bulletin*, 45:155–167.

Stewart, P. A. 1937. A Preliminary List of Bird Weights. *Auk*, 54:324–332.

Taber, W. B., Jr. 1928. A Method to Determine the Weight of Food Digested Daily by Birds. *Auk*, 44:339–341.

Wetmore, A. 1936. The Number of Contour Feathers in Passeriform and Related Birds. *Auk*, 53:159–169.

Wetherbee, Mrs. H. B. 1934. Some Measurements and Weights of Live Birds. *Bird-Banding*, 5:55–64.

Whittle, C. L. 1927. Some Additional Bird Weights. *Bull. Northeastern Bird-Banding Ass.* 3:70–71.

1930. Additional Live Bird Weights. *Bird-Banding*, 1:192–193.

Whittle, C. L. and H. G. 1926. Some Bird Weights. *Bull. Northeastern Bird-Banding Ass.*, 2:33–36.

Zedlitz, O. 1926. Vogelgewichte als Hilfsmittel für biologische Forschung. *Jour. f. Ornithologie*, 74:296–308.

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SOME RESULTS FROM ADULT TERN TRAPPING IN THE CAPE COD COLONIES.[1]

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THE Cape Cod tern population comprises three large colonies varying from 20,000 to 40,000 breeding individuals, six or seven smaller groups of between 200 and 2,000 birds each, and a yearly increasing number of still smaller units scattered widely along the beaches. Each larger group is augmented by a considerable number of individuals which either have not arrived at the procreative age or have passed it.

Yearly variations in ecological conditions change the size of these individual groups, but adult trapping and failure to take elsewhere along the Atlantic coast during the nesting season birds banded on Cape Cod, show that this population is coherent, augmenting and also replacing inevitable losses by its own reproduction alone. About forty miles south of the nearest of the Cape colonies, in Nantucket Sound—this being the same as the distance between the extreme Cape groups—are three large tern rookeries, yet of the 4,983 returns trapped in the Cape colonies only twenty-six were banded on the Nantucket Islands.

Equally distant from the Cape Cod and Nantucket groups is a colony of several thousand nesting terns on Ram Island, investigated by us this year for the first time. In it seventy adults were trapped, of which thirteen or 18.6 per cent were returns. Of these last, six were banded as adults in one of the Cape colonies, four while chicks in the Nantucket group; seven were banded in 1935-36, and six in 1933-34. Only one tern banded there has been taken on the Cape.

Tern banding has been done on Cape Cod since 1922, for several years in smaller numbers, intensively for the last five seasons. There have been banded here 95,984 chicks and 16,723 adults, totaling 112,707. A resumé of the work already done was published in 1934. A perusal of this and other articles published in *Bird-Banding* dealing with the Cape's terns will orientate a readier and clearer picture of this report. For the last three years in our work with the *Sterninæ*, adult trapping has been the major undertaking of this Station, 11,416 adults having been banded and 4,624 returns taken in the Cape groups during this period. In all there have been 4,983 recaptures of banded terns.

The only satisfactory and safe method of taking adult terns is trapping them individually on their nests. This fails the day the eggs hatch, for at once the chicks seek the shelter of nearby verdure or litter, returning to the nests only for periodic brooding or feeding. The instinctive impulse for adequate incubation which impels terns

[1] Contribution No. 27 from the Austin Ornithological Research Station.

unhesitatingly to enter traps over their eggs ends with hatching and seldom will a parent enter a trap placed over chicks in its nest. A simple drop trap of chicken-wire, two and one-half feet square with sides five inches high is used. Originally this was tripped by a string running from the supporting stick to a blind. Takes were unsatisfactorily few by reason of time consumed in setting traps; the continuous presence of humans in one small sector of a colony not only inhibited a return to the nests but also incited emigration and renesting elsewhere, especially early in the season. Almost always terns alight a short distance leeward and walk into the wind onto the nest. They arise from the nest into the wind, especially if alarmed. Consequently if the rear of a drop trap is placed on the ground to windward of a nest, the front elevated and balanced delicately on a slender stick, a departing bird, by touching the top of the trap, springs it immediately. Such sets, in groups of ten to twenty each, the groups from fifty to one hundred yards apart, increased the captures greatly. Working at these groups in rotation disturbs the breeding to a minimum. Efficiency is enhanced by small changes in the method of setting traps determined by variations in the wind, temperature and sunshine. It is possible to take almost every bird entering a trap by a simple arrangement of strings close to the ground between the supporting stick and the sides of the trap but this has been discarded for it entails both egg breakage and injury to the birds.

No method of capturing the "drone" members of a group which idle in rows along adjacent beaches has been found, but their presence has been shown by the taking of three different birds on a specified nest. This behaviour is only the vicarious release of immature sex-impulse and not the utilization of surplus labor, for, normally, communism is never exhibited by terns.

If the imperative reproductive accomplishment of a colony is to be conserved adult trapping must be done with judgment and restraint. Frequent rest days must be given whole colonies as well as sections of them, unsprung traps must often be removed *en masse*. In 1936, concentrated trapping resulted in extensive emigration and renesting on other sites. When these birds were retrapped subquently the same season it was found that they had not scattered as individuals but frequently had relocated in compact units duplicating largely their grouping in the primary nestings.

Three species comprise the Cape Cod colonies, *hirundo, dougalli* and *paradisaea*, in a rather consistent proportion; two-thirds are *hirundo*, one-third *dougalli* with, at most, four hundred *paradisæa*. The higher survival rate of *dougalli* chicks compensates the relatively larger broods of *hirundo* chicks to maintain partially this ratio, also the greater virility and adaptability of *dougalli* result in more frequent and longer adult survival. The divergent behaviour of the *dougalli* makes trapping them far more difficult and is responsible for the following:

Living adults trapped in	*1935*	*1936*	*1937*	*Total*	*Per cent*
Hirundo.....	3,732	6,882	4,501	15,115	96
Dougalli.....	239	427	21	687	4

This same species ratio of captures holds good, with explicable variations, for the work of all preceding years. *Hirundo* elects to nest in open terrain; *dougalli* sites are only in densely vegetated territory when available. Traps cannot be operated in locations of the second type without the removal of the greater part of the grass or plants. The likelihood of nest desertion is in direct relation to the degree to which nest surroundings have been altered. Usually, the *hirundo* reproduction cycle is two weeks in advance of the *dougalli*, the bulk of the latter species arriving on breeding grounds a week after the majority of the former, but courtship is delayed a week, not beginning at once as it does with *hirundo*. In 1936 at Tern Island, our largest and earliest breeding colony, for two and one-half weeks *dougalli* constituted 75 per cent of the population and nest-scooping began at once. This permitted trapping them before the beach-grass had grown enough to necessitate its removal and resulted in an unusually large take.

It is grieviously erroneous to compare bird behaviour with that of humans, for into the latter enter important determining factors foreign to the former. Nevertheless the actions of both are similar to a degree when they are either the outcome of unalloyed biological urge or are but crudely modified by most elementary psychological processes. The safety in numbers, the lack of ordinary caution by masses and the vigilance of settlers explain the divergent reaction to trapping by large and small colonies. The smaller and younger the colony, correspondingly greater is the difficulty experienced in trapping it from the standpoints of time consumed, number of possible takes and the inhibition of incubation. Annually, a group of from ten to fifty Arctic Terns nest on an extensive, unbroken, unvegetated sand-spit at the end of Nauset Point. It has never been possible to trap more than six of these during a nesting. Billingsgate Island is exactly similar terrain, but since between 1,000 and 3,000 individuals, predominantly *hirundo*, nest there and far more compactly, the trapping is almost as productive as it is in the two large rookeries. However, each revisit to this colony in one year affords almost geometrically less in trapping yield, while at Tern Island, if other factors affecting trapping are equal, takes from each set do not decrease as the season advances. Evidently psychological reaction to an important occurrence and behaviour adjustment are greater and more prompt in small than in large groups.

TABLE 1

ADULT TAKES 1928 TO 1937, INCLUSIVE

Year	*Banded*	*Returns*	*Total*	*Banded Per cent*	*Return Per cent*
1928.....	164	5	169	97.03	02.98
1929.....	918	31	949	96.73	03.26

1930	248	16	264	93.9	06.1
1931	86	11	97	....	....
1932	1239	80	1319	94.00	06.00
1933	2648	209	2857	92.68	07.32
1934	4	7	11	....	....
1935	3425	629	4054	84.43	15.52
1936	5435	1990	7425	73.20	26.80
1937	2556	2005	4561	56.05	43.95
Total	16723	4983	21706	77.04	23.06

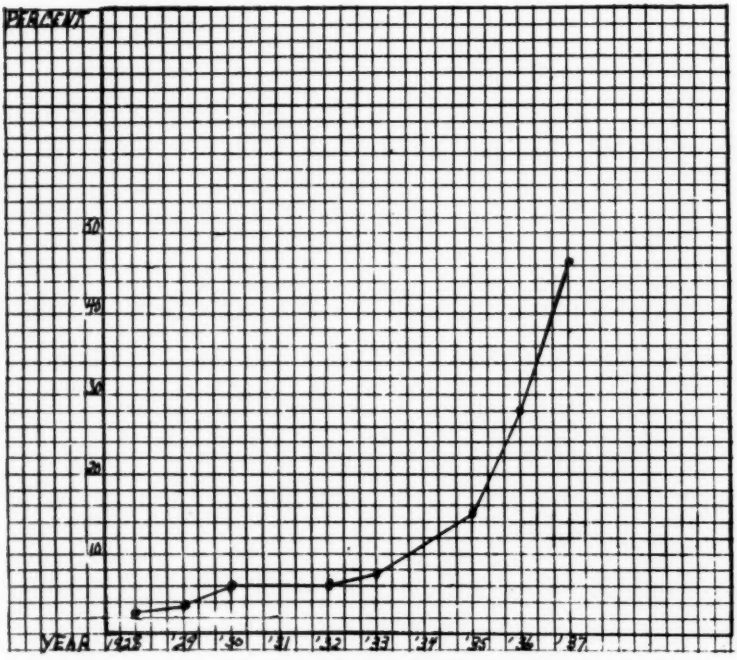
TABLE 2

RETURNS 1928 TO 1937, INCLUSIVE

Year	*Banded as Juveniles*	*Per cent*	*Banded as Adults*	*Per cent*	*Total*
1928	5	100.	0	0	5
1929	28	90.32	3	09.68	31
1930	10	62.5	6	37.5	16
1931	6	54.55	5	45.45	11
1932	38	47.5	42	52.5	80
1933	78	37.32	131	62.68	209
1934	0	0	7	100.	7
1935	181	28.75	448	71.25	629
1936	328	16.47	1662	83.52	1990
1937	363	18.11	1642	81.89	2005
Total	1037	20.88	3939	79.15	4983

The tables above summarize all adult takes in the Cape Cod Colonies and show some trends of the work being done. For analytical purposes the sampling may be considered representative and adequate excepting for two of the years: In 1931, the captures were few in comparison to other seasons, they were in groups atypical in composition by species and previously banded individuals, consequently their obvious inconsistencies both in numbers and percentages must be discarded. In 1934, in order to determine the efficiency and actual accomplishment of experimental conservation measures, disturbance of nesting birds was minimized by limiting trapping to the capture of eleven adults desired for particular individual study. That seven, or 64 per cent, of these were returns is dismissed as an artifact. These two hiatuses, however, are inconsequential in the determination of trends for both were preceded and followed by several years of typifying takes. Although the data presented in the tables are sufficient, both in volume and in the span of years covered, to warrant credible deductions these must not be considered conclusive and final, for facts obtained during the last three years have confuted earlier concepts of breeding ages and survival rates.

The rapid yearly rise in the percentage of returns in a season's takes (see graph number 1) condones any sacrifice of conservation resulting from capturing a large quota in a colony. So high is chick mortality and also that of juveniles—approximately ninety-five per cent of birds killed on the winter range are birds-of-the year—

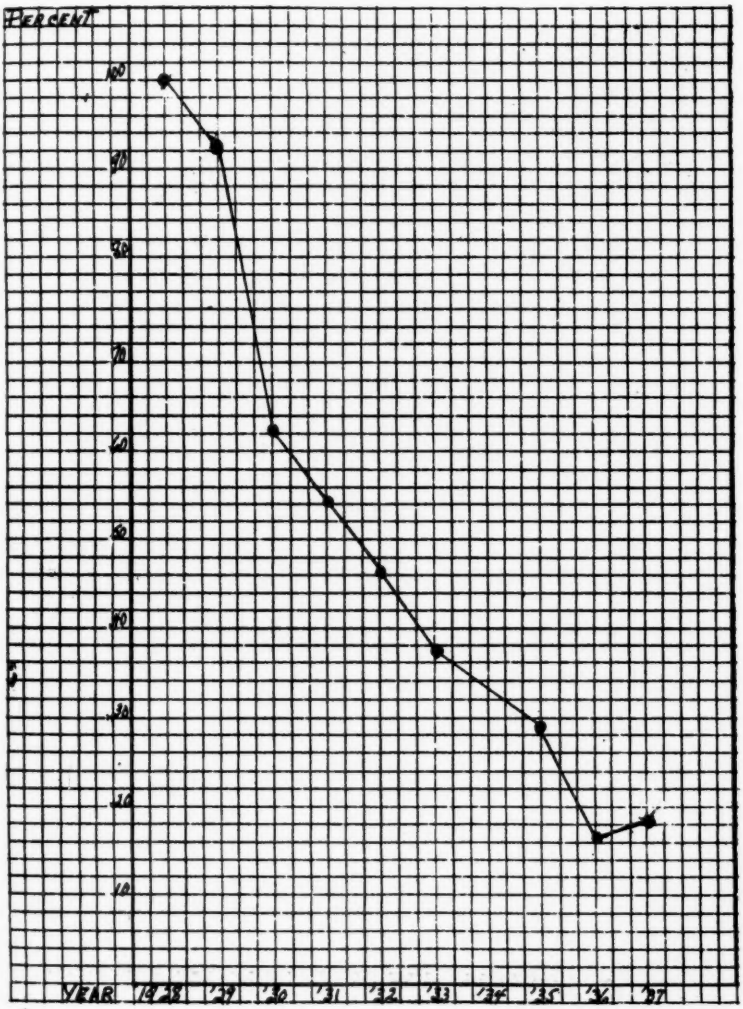


GRAPH 1

Graph 1 is based on the percentage of returns in the total adult takes for each year.

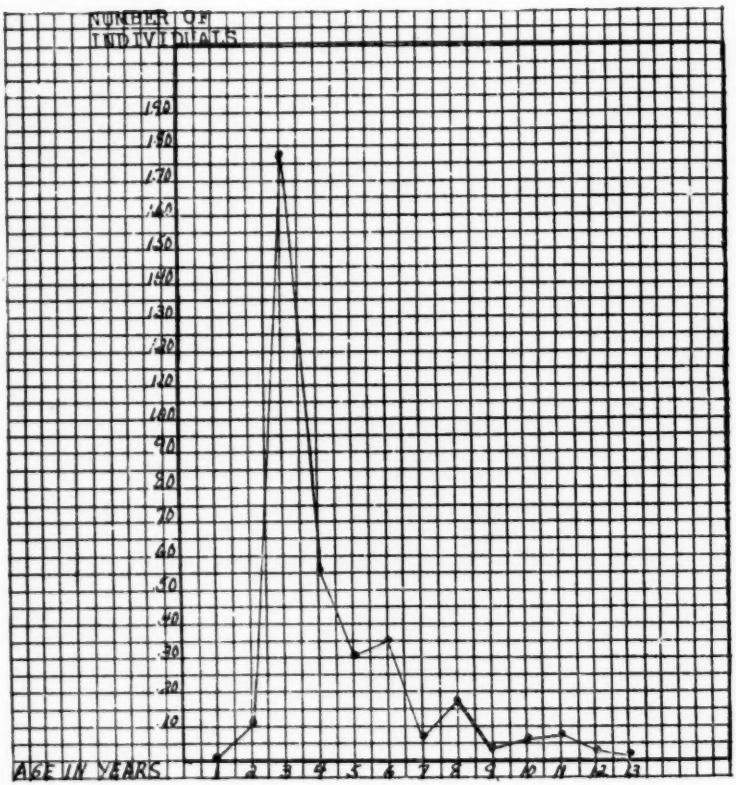
that bandings done at these ages give an incomplete and erroneous picture of the composition of a colony. For the first seven years the returns were consistently below ten per cent showing no rise paralleling the increasing number of chick bandings. As a result of the magnitude of adult bandings since 1933 the percentage of returns increased in 1937 to 43.95 per cent. This and other corroboratory findings suggest that the bulk of a colony, on which its prosperity depends, consists of adults in the prime of life, gregarious from the standpoint of clanship. As a corollary to this it appears that the perpetuation of these terns, provided requisite ecological conditions prevail, depends not on augmentation by very large numbers of juveniles but on the well-being and success of this group of physically mature and perfect adults possessing an adaptability greater than that of the average for the species.

The terns are well specialized species at best, but the juveniles are more exacting than adults in the requisition of agreeable en-



GRAPH 2

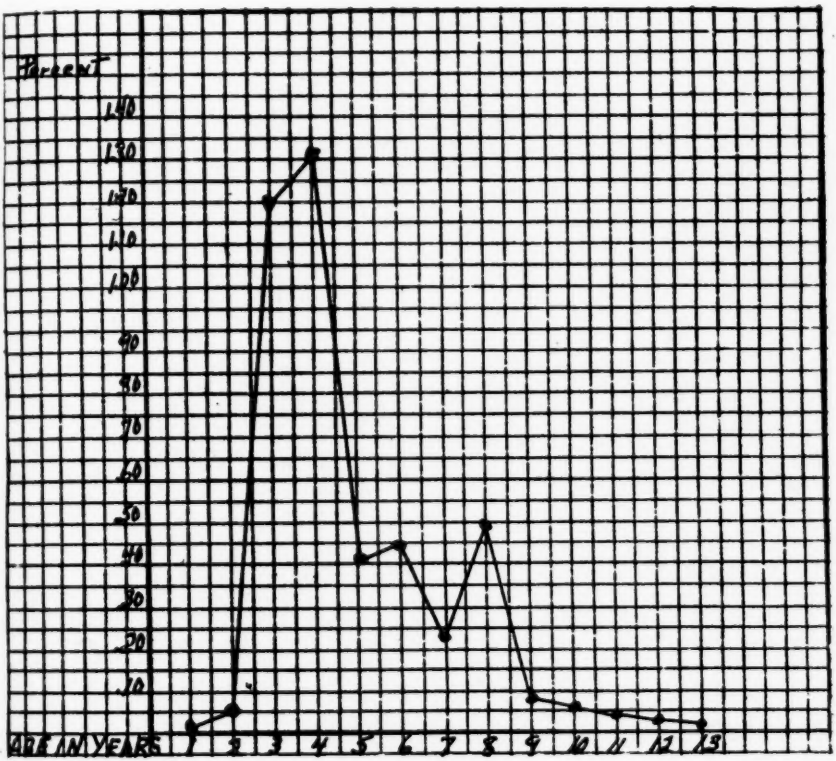
Graph 2 is based on the percentage banded as chicks in each year's total returns.



GRAPH 3

Graph 3 is based on the ages of returns taken in 1937 which had been banded while chicks.

vironment if they are to survive and procreate successfully. The presence of humans, molestation by an owl, and similar minor interferences drives them to prompt nest-abandonment whereas only some major catastrophe such as a serious food shortage or the destruction of all their eggs will force the virile, tenacious adults to emigrate for renesting. Birds nesting for the first and less often the second time rarely have more than two eggs in their clutches, commonly but one, and we have no record of four eggs having been laid in an initial nesting. More mature individuals always have at least two eggs, most frequently three and very often four. After making generous allowances for all known and suspected influencing



GRAPH 4

Graph 4 is based on the ages of returns taken in 1937 which had been banded while chicks and shows the percentages of returns of various ages to the total number of chicks banded in the respective years of birth.

conditions, it cannot be shown that the size of any year's hatch and chick survival has any corresponding increase or decrease in the whole Cape's or a particular colony's population three and four years later, the known time for breeding by these birds to begin. Graph No. 2 accentuates the relative unimportance of juvenile replacement and accretion especially since gaps made by death in the hardy group are filled by birds of duplicating age dispersed from other colonies. The final eighteen per cent cannot be the probable annual juvenile accession for in 1937 our reclamation work afforded unprecedentedly suitable conditions for juvenile nesting and is

responsible for a rise rather than a beginning leveling off of the curve in the graph.

In earlier articles dealing with the Cape Cod terns there were postulated and given as much proof as the available data warranted, statements concerning the breeding ages of terns. Since these were based on the exceedingly small number of ninety-seven individuals of known ages with a minimum allowance for possible variables it has appeared to be advisable to check the correctness of these findings by a comparison with the data since obtained.

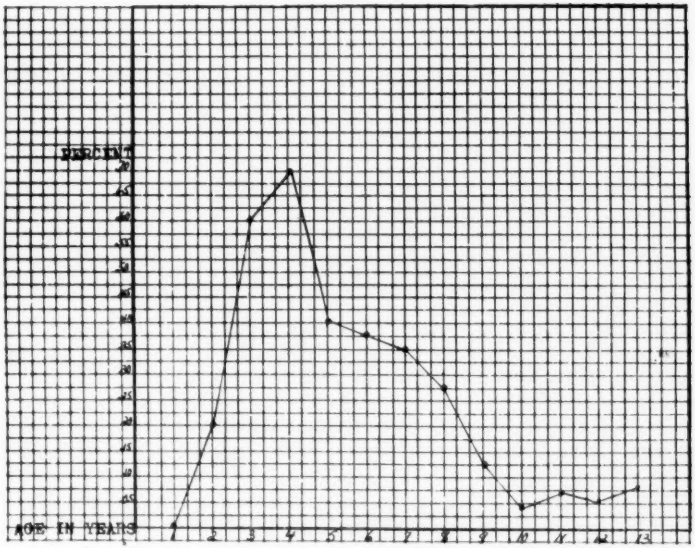
Returns banded as chicks taken in:

1935	181
1936	328
1937	363
Total	872

When the 1937 takes of birds banded while chicks are plotted (see graph No. 3), the ordinate representing the number of birds of known ages and the abscissa showing the ages, the picture corresponds almost exactly with the one obtained in 1932. Both these chartings fail to minimize the error inevitably consequent to wide variations in the number of yearly chick bandings. This fallacy is best eliminated by plotting the takes of each age in percentage of the total chicks banded. When this has been done (see graph No. 4), a picture is presented more like the unconfirmed impressions acquired while working in the field and compiling records. Discarding the recaptures of many birds a second and third time in years subsequent to their initial return, we have accumulated a total of 1,037 individuals banded the season of their hatching and trapped on nests thereafter between 1929 and 1937 inclusive.

When this huge sample is mapped by the percentage method used in graph No. 4, each point being the average for the combined years correctly superimposed according to ages (see graph No. 5), a reliable basis for deduction has been established. If it were possible to alter the locations of several points by utilizing numerous known occurrences and vagaries of chance which have caused distortion from absolute fact, a fairly smooth curve could be constructed with the second year mark much lower, the fourth year peak still higher than it is and the fifth and sixth year positions close to the descending arc.

Since we know that egg-laying by a tern the summer following the one of its birth, if it does occur, is anomalous, also that incubation the following year is a precocious and usually futile expression of an incompletely developed sex-urge, it appears that terns do not begin procreating actively until the end of their third year, attain maximum accomplishment in their fourth, retain high but slowly decreasing fecundity for three years more, then rapidly decline until, at decade, they reach almost at zero a level at which they



GRAPH 5

Graph 5 is constructed exactly as was Graph 4, but the points, rather than being the percentages for a single year, are the average for all the years 1929 to 1937, inclusive.

remain for the remainder of their lives. Without even intimating in this contribution our opinion concerning the longevity of terns, it is believed that the relatively small number of takes of breeding birds ten and more years old is due to mortality rather than to involutionary processes with resulting sterility. Only from incredible analogy can it be assumed that wild birds survive to a terminal period of propagative impotence. Care has been taken to follow through the nesting of a number of thirteen-year-old individuals. Their clutches are always average or larger, the fertility of their eggs is normal, and their chicks offer no evidence of physical inferiority. These relatively old birds present plumage changes, such as marked whitening of the feathers on the crown, which render them easily recognizable by any observing bander who has handled many thousand adults. Never have we been able to find them in the large groups of non-breeding birds frequenting the shorelines; always we have succeeded in retrapping them on their original nests.

Our lack of banding evidence of breeding by terns more than thirteen years old is no criterion for assuming that fecundity terminates at this age. Almost all of the bands on birds more than ten

years old are worn so thin that they are open for one-eighth of an inch or more, and they frequently fall apart when handled. We have found repeatedly, when these birds have been recaptured seasons subsequent to the one in which an additional band had been placed on the other tarsus, that the original band had disappeared. At Tern Island we have never taken a bird more than ten years old beyond the limits of one small sector of the large nesting area; we know that many terns, by election, return year after year to nest on the same particular spot in a rookery even more consistently than many passerine birds renest in an identical bush or box. Consequently when in the same area, we trap annually a number of unbanded birds which, because of their exhibition of the plumage characteristics previously mentioned, are probably of advanced age, it is likely that either they have lost their worn out bands, were missed when their contemporaries were ringed, or even were hatched before banding was initiated on the Cape.

Sixteen consecutive years of tern banding in this geographically rather isolated Cape group afford ample ground work for determining the methods by which a new colony is founded, appraising its make-up and estimating its potentialities, especially since this span of time includes fifteen years of wholesale chick-banding and six seasons in each of which from 1,000 to 7,000 adults have been taken. A decade and one-half ago, on Jeremys Point, a colony of several thousand birds was approaching the peak of its prosperity. Before the usual factors which determine the inevitable decadence began functioning, this colony became over-run by mammal predators which decimated its population annually, for its was situated on a peninsula. The late Mr. Forbush with others attempted in vain to rescue the rookery by building a wire fence across the narrowest part of the isthmus. This failed to check the inroads by numerically increasing predators and this molestation, the cause usually of only partial and transitory departure of a group of terns routinely tenacious in site occupancy, became the determining cause of the entire colony's scattering to Tern, Egg and Billingsgate Islands, at the moment ecologically ideal for a colonial nesting. Annually, since 1929, we have prospected this site adequately enough to be certain that not one pair of terns has nested. In mid June, this year, strictly local food shortage, shrinkage and destruction of available nesting territory with other unusual disturbing occurrences determined a patent emigration of nesting birds from the three largest Cape groups. At this time shell-fishermen who work daily in the vicinity of Jeremys Point sent us word that a large group of terns had begun nesting there, a full month after the reoccupation by its usual population of Billingsgate Island less than two miles distant. The site has become insular when the tide is very high and is ecologically ideal from the standpoint of the desideratum of breeding Common Terns. We found a colony of over 2,500 birds, overwhelmingly *hirundo*, nesting actively and we succeeded in

trapping there 425 adults, of which 141, or 33 per cent were returns. Of these takes only three were *dougalli*, one *paradisæa*, all unbanded.

If the ornithological dictum that the young of most species, when they reach procreative age, scatter to the occupancy of new territory applied to terns, certainly there would have been some few individuals nesting on Jeremys Point last year or at least within two and one-half weeks of the general Cape nesting this year, which did not occur. The seventeen day margin is allowed since work done from the first days of several years' reoccupancy at Tern Island and Egg Island, the former always from ten to fourteen days in advance of all other Cape groups in the whole nesting cycle, has shown that the oldest birds are the first to return, nest and incubate, those three or four years younger are a week slower, whereas the youngest returns nest in the more scantily occupied and less desirable territory about two weeks after the initial egg-laying.

But the best evidence that this new settlement did not originate in selection by a group of juniors of an unoccupied tract is found in the analysis of the captures here of birds of known age. While, in percentages, the ages duplicate closely in most respects those found to prevail in the oldest colonies, there is a much higher proportion of individuals four years old, the peak of tern virility. Two-year-olds were but one-tenth the usual ratio; not one 1936 chick was captured. On the other hand, only one bird at least seven years old was taken and of those known to have nested elsewhere earlier in the year but one of six years. This, of course, confirmed anticipations for when, in a large colony, disruptions of any sort produce a considerable renesting, the more senile birds repeat their undertaking on the original site. The probable correctness of these findings is corroborated by the constituency of other young and much smaller Cape flocks.

It is demonstrable that this Jeremys-Point colony was founded by an aggregation of birds in the prime of life compelled to forego the occupancy of the site they normally would elect by reason of its being unavailable or untenable. In all the colonies there are each year some few individuals who are either regularly or seasonably nomadic, but the percentage of such birds in this new group was many times greater than previously found elsewhere. Since this behaviour may be due to a relatively late hormone development obviously these individuals, their normal nest sites preëmpted, would ally with a flock seeking a new site. For their first nestings of the season birds came to Jeremy's from ten different locations, even from the Nantucket colonies, and also from Pamet Point, Little Sipson and North Point where conditions showed no influencing change from those of former years. But the preponderance of possible primary nesting birds, 66 per cent of all the returns, came from sites without usable terrain. From Egg Island, where rapid erosion has so abridged the land that nests were everywhere in a proximity both unprecedented and inconsistent with average

reproductive survival, came 28 per cent of these; from Billingsgate Island, similarly destroyed by the elements, came another 20 per cent, while 43 per cent were from Tern Island, where, while suitable territory exceeded by twice that of the preceding year, there was so great a dearth of sand eels and minnows which constitute the usual tern dietary that surface feeding on minute forms of ocean life was resorted to. Of the banded birds taken at Jeremys Point, 27 per cent were renesting birds trapped earlier in the year at other sites; of these 74 per cent were first caught while incubating at Tern Island and in age were within the three year epoch of the maximum reproductivity of terns.

In this paper a few statements have been made which were based largely on field work and observations; for most of these there are several duplicating or confirmatory entries in our daily notes. All others have been made only after verification by tabulations, charts and graphs constructed solely from the meticulously detailed recording of each take. In order to save the space necessary for their publication these have been omitted, but, together with many not utilized, they are available to those who desire making their own deductions or for supplementing those which have been made.

BIBLIOGRAPHY

AUSTIN, O. L.
1932. "The Status of Cape Cod Terns in 1932." *Bird-Banding*, Vol. III, No. 4, October, 1932, pp. 143–156.
1934. "The Status of Cape Cod Terns in 1934." *Bird-Banding*, Vol. V, No. 4, October, 1934, pp. 155–171.

AUSTIN, O. L., JR.
1929. "Contributions to the Knowledge of the Cape Cod Sterninæ." *Bull. N. E. B. B. A.*, Vol. 5, No. 4, October, 1929, pp. 123–140.
1930. "The Statistical Trends of Banding." *Bird-Banding*, Vol. I, No. 1, January, 1930, pp. 20–28.
1932. "Further Contributions to the Knowledge of the Cape Cod Sterninæ." *Bird-Banding*, Vol. III, No. 4, October, 1932, pp. 123–139.
1933. "The Status of Cape Cod Terns in 1933." *Bird-Banding*, Vol. IV, No. 4, October, 1933, pp. 190–208.

BAYNARD, O. E.
"Foods of Herons and Ibises." *The Wilson Bulletin*, No. 81, Vol. XXIV, pp. 167–169.

BENT, A. C.
1921. "Life Histories of North American Gulls and Terns." Smith, Inst., U. S. Nat. Mus., *Bull.* 113, 1921, pp. 236–264, 109–112, 160–161.
1926. "Life Histories of the North American Marsh Birds." Smith, Inst., U. S. Nat. Mus., *Bull.* 135, 1926, pp. 207–208.

BREWSTER, W.
1879. "The Terns of the New England Coast." *Bull. Nuttall Ornithological Club*, Vol. 4, No. 1, January, 1879, pp. 13–21.

FLOYD, C. B.
1925. "Six Days in a Massachusetts Tern Colony." *Bull. N. E. B. B. A.*, Vol. I, No. 4, October, 1925, pp. 58–60.
1926. "Additional Experiences in Banding Terns at Tern Island." Chatham, Mass., *Bull. N. E. B. B. A.*, Vol. II, No. 4, October, 1926, pp. 68–72.
1927. "Notes on the Development of Young Common and Roseate Terns." *Bull. N. E. B. B. A.*, Vol. 3, No. 4, October, 1927, pp. 95–101.

1928. "Notes on Banding Terns at Chatham, Mass., for 1928." *Bull. N. E. B. B. A.*, Vol. IV, No. 4, October, 1928, pp. 125–132.
1929. "Notes on Banding Terns at Chatham, Mass., for 1929." *Bull. N. E. B. B. A.*, Vol. V, No. 4, October, 1929, pp. 144–148.
1930. "Further Banding Notes from Tern Island, Mass." *Bird-Banding*, Vol. I, No. 4, October, 1930, pp. 181–184.
1932. "Report of Tern Banding on Cape Cod During 1932." *Bird-Banding*, Vol. III, No. 2, April, 1932, pp. 63–65.

FORBUSH, E. H.
1925. Birds of Massachusetts and Other New England States, Vol I, pp. 105–126.

BIRD MALARIA AND MOSQUITO CONTROL

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THE purpose of this paper is to point out that a large percentage of birds in nature are infected with a mosquito-borne malaria, and that this fact presents a phase of a problem of wild-life management that has been overlooked almost entirely.

OCCURRENCE OF PLASMODIUM IN NORTH AMERICAN BIRDS

The causative agent of malaria in birds was discovered in 1885, only five years after it was first recognized in man. Although malaria parasites have been reported from many species of birds throughout the world, very little is as yet known of their prevalence among the avifauna or the effects on the avian population.

In its broadest sense, malaria, which originally meant "bad air", may today be interpreted as applying to the diseases caused by the blood-inhabiting protozoa of the family Plasmodidæ. At least three genera of Plasmodidæ have been reported from birds: *Leucocytozoön*, *Hæmoproteus*, and *Plasmodium*. All these forms live within red blood cells. Only one genus—*Plasmodium*—is known to occur in man. There has been much experimental investigation on the *Plasmodium* of birds which has had direct bearing on the human malady. Mosquito transmission was first worked out with birds in India by Ross in 1898. Most of the recent advances in drug treatment of malaria have been tested first in the laboratory on canaries. Studies of avian *Plasmodium*, however, have been mainly with laboratory birds and have not added greatly to our knowledge of the conditions in the wild bird hosts.

Most protozoölogists recognize only three valid species of *Plasmodium* as occurring in man. However, as has been shown recently by Manwell (1935), there are at least eight valid species prevalent

[1] Contribution No. 30, Austin Ornithological Research Station.
Read at the 55th annual meeting of the American Ornithologists' Union at Charleston, South Carolina, November, 1937.

in birds from North America alone, and several other species have been isolated elsewhere. More than thirty of our North American species of birds have been observed to harbor at least one of these species of *Plasmodium*. No doubt, further study will reveal a more widespread prevalence among our avifauna, with perhaps even added species of the parasite.

In order to understand the importance of *Plasmodium* infections in our wild birds it is necessary to know something of the prevalence within a single species of bird. Although our knowledge is still quite limited, recent studies on a few of our birds present some tangible facts. Most studies have been based merely on the examination of a single blood-smear from a bird. Very little value can be attached to such a method if it is to be interpreted as a picture of the total prevalence of infection. Mostly from studies with canaries, it has been learned that when a bird becomes infected it is usually a week or two before parasites are in the blood in sufficient numbers to be found on examination of the blood film, and in one case—*Plasmodium polare*—the incubation period may be several months. With most of the species the acute infection lasts but a few days, and within a short period the parasites are so few in number in the blood of the infected bird as to be rarely seen by examination of a blood-smear. Relapses are known to occur in experimentally infected canaries, but we have no knowledge of their frequence in the natural infections of the wild birds. Thus it is that *Plasmodium* species can be diagnosed by routine blood-smears only during a short period of the bird's life. However, by injecting some of the blood from a wild bird into a malaria-free canary, the canary will usually develop an acute initial infection which can easily be demonstrated if periodic smears are made every few days. This procedure was tested by Manwell and Herman (1935) with a series of birds captured in the vicinity of Syracuse, New York. The most outstanding of the results obtained was with a series of twenty-nine Song Sparrows (*Melospiza m. melodia*). Only six were diagnosed from blood-smears, but injections into canaries disclosed seventeen—well over fifty per cent—to be infected with at least one species of malaria. This method of procedure gives a closer approximation of the true prevalence of *Plasmodium*.

During the summer of 1936, blood-smears were made from 193 Eastern Red-wings (*Agelaius p. phœniceus*) at the Austin Ornithological Research Station on Cape Cod. Of this number, only seven were diagnosed with *Plasmodium* (Herman, 1938). During the summer of 1937 blood from forty-eight Red-wings was subinoculated into canaries. *Plasmodium* was subsequently diagnosed in at least twenty-nine of these canaries—thus demonstrating a prevalence of well over sixty percent in the Red-wings.

The prevalence of malaria in the Eastern Robin (*Turdus m. migratorius*) is even more striking. As early as 1904, Novy and MacNeal

reported *Plasmodium* to be common in Robins in Ann Arbor, Michigan. All the adult Robins examined in the laboratory of Dr. R. D. Manwell at Syracuse University within the past few years (at least thirteen birds) have been infected with at least one species of *Plasmodium*, and the few adult Robins that have been studied by the author at the Austin Station (seven birds) also have been infected.

EFFECT ON THE BIRDS

The high prevalence of this disease in our wild birds having been determined, the next question which presents itself is the detrimental effects of the disease on the health of the individual. Although fatalities from malaria frequently occur in humans, death is often caused by complications or secondary invaders, particularly pneumonia. Relapses also frequently occur after surgical operation or after a shock or strain of any description. Whether or not an analogous condition prevails in birds is not known. It is known, however, that pneumonia is a common cause of death with birds kept in captivity. It has never been determined whether *Plasmodium* infections in any group of birds is responsible for great losses, such as O'Roke (1934) has shown to be the case with *Leucocytozoön* in young ducks. Nevertheless, so many of the red blood cells of the bird are destroyed by the parasites that the health of the individual must be impaired considerably and the resistance of the bird thus markedly lowered. It must be emphasized that small birds, when they become weak from illness, are easily captured by predators. Also, if birds are dying of malaria in nature it would be unlikely that they would be found by man. Except in severe epidemics, dead birds would be hidden from the sight of man and would be quickly devoured by carrion animals. In the case of the infections observed in the Red-wings examined during the past two summers at the Austin Station only one bird has been under observation while it had a heavy acute infection obtained in nature. This bird did not seem to be suffering any noticeable ill effects, and the only indication of the disease was the great number of parasites to be seen in its blood-smear. However, canaries inoculated with the Red-wings' blood demonstrated a very high mortality during the acute stages of the infection—more than half the infected canaries succumbed to the disease. Two species of *Plasmodium* were diagnosed, *P. circumflexum* and *P. cathemerium*. The former species is about twice as abundant and apparently more pathogenic. All cases observed in the blood-smears from the Red-wings were *P. circumflexum*. *Plasmodium cathemerium* was diagnosed only by injection into canaries. It may be that the Red-wings have a greater immunity to the one species, but further studies and research will be necessary to determine to what extent the disease in wild birds parallels the conditions in the human ailment.

TRANSMISSION

The Plasmodidæ are transmitted from one host to another by blood-sucking insects. The parasites develop within the insect, and the stages which are infective to the vertebrate host become concentrated in the salivary glands. During the process of sucking blood these insects inject saliva containing the parasites and thus transmit the infection into the blood-stream. Certain groups of insects have been found to be responsible for the transmission of specific parasites, and it has been demonstrated that under normal laboratory conditions the parasites will reach maturity—so as to be infective to new hosts—only in particular insects. Thus it has been found that *Hæmoproteus* is transmitted by louse-flies (Hippoboscidæ), *Leucocytozoön* is transferred from one animal to another by black flies (Simulidæ), and the vector of the genus *Plasmodium*—as is well known—is the mosquito. Curiously enough, the malaria of man is transmitted by a different group of mosquitoes from those responsible for the transference of *Plasmodium* in birds. The malaria of humans is transmitted by anopheline mosquitoes, while the culicine group have been shown to be the vectors of the bird disease. It is a simple matter for an experienced person to tell these two groups of mosquitoes apart. Most malaria studies have been done with those mosquitoes implicated in human malaria, but several investigators have determined some of the species of mosquitoes capable of transmitting bird malaria. In fact, as previously stated, mosquito transmission of malaria was discovered with birds even before it was known to be the means of contracting the disease in humans.

Different species of culicine mosquitoes transmit different species of bird malaria. The most common vector is *Culex pipiens*, which has been shown to be capable of transmitting three of the commonest species of bird plasmodia in the United States. This mosquito is often popularly referred to as the "house" mosquito, and it breeds in the temperate regions throughout the world. It can be found breeding in swamps, but becomes particularly abundant in rain-barrels or other standing water about human habitations. During the past summer it has been found to transmit readily one of the species (*P. cathemerium*) obtained from the Red-wing, as well as the same species of malaria obtained from a Cowbird (*Molothrus a. ater*). However, this species of mosquito is immune to *Plasmodium circumflexum*, the species found to be most prevalent in the adult Red-wings at the Austin Station.

The only species of mosquito which has thus far been found to be capable of transmitting the *Plasmodium circumflexum* of the Red-wing is *Theobaldia melaneura*. Very little is known of the habits of this mosquito. Matheson (1929) states that it occurs in the eastern United States from the Gulf of Mexico to Canada, and that it is rare and local. It breeds in permanent water in swamps, and on Cape Cod has been found to be most abundant in a wooded

swamp in the pools of water under the roots of the trees. Several attempts to transmit *P. cathemerium* with this mosquito have been unsuccessful, and as yet it has not been tested on any of the other species of plasmodia. One other species of *Theobaldia* (*T. morsitans*) occurs in North America, but this species has not been tested as a possible vector of bird malaria.

Another species of mosquito I have found to be capable of transmitting *Plasmodium cathemerium* from the Cowbirds and Red-wings is *Aedes sollicitans*. This is the common salt-marsh mosquito. It breeds in the salt marshes along the Atlantic and Gulf coasts. However, Huff (1927) experimented with this mosquito as a possible vector of several species of malaria obtained from English Sparrows (*Passer domesticus*) and found it immune to a strain of this species of malaria. This demonstrates that mosquitoes are specific as transmitters not only for particular species of bird malaria, but possibly also for certain strains of the same species, or perhaps that there is an immunological difference in mosquitoes collected from different localities.

Several other of the more common culicine mosquitoes have been shown experimentally to be capable of transmitting various species of bird plasmodia, but no positive reports have been published on the vectors of some of the more recently discovered species.

CONTROL MEASURES

For many years conservationists and ornithologists have been opposed to many of the mosquito-control projects, particularly those involving drainage, as being detrimental to wild life. It has been felt that these conservationists have not been aware of the prevalence of malaria in birds and therefore have not seen this side of the problem. It would be utterly impossible to control the malaria of birds by any other method but the eradication of the vectors. In the case of *Plasmodium*, this would mean mosquito-control. With the exception of certain methods of Paris green dusting, projects for the control of the mosquitoes responsible for the transmission of human malaria often serve to rid the environs of many of the culicine species as well. Several of the species responsible for the transmission of bird malaria, though not locally implicated as vectors of any human disease, are nevertheless looked upon as pests because of the discomfort they bring to the human race and are therefore controlled along with the anopheline species.

In a recent editorial in *Bird-Lore* (1935) mosquito control in isolated regions away from the vicinity of settlements is condemned as an unnecessary waste of funds as well as detrimental to the wild life of the area. Often, locally, in regions where human malaria is no longer endemic, mosquito-control projects are taken to task by conservationists as being unnecessary and serving only to upset the ecology of the wild life, especially the birds. It must be agreed, at the start, that there are not, by any means, sufficient data to prove

the value of mosquito-control to the reduction of bird malaria. However, the admirable results in the reduction of human suffering from malaria by these control measures should serve as an excellent example as to what might be done for the birds. We cannot expect to obtain funds for mosquito-control as a means of reducing the prevalence of bird malaria. However, it is indeed fortunate that the control measures for the pests of the human race often also serve to reduce the numbers of mosquitoes which feed on the birds, even species which do not feed on man.

Control of mosquito-borne avian malaria is, at present, not an urgent measure. The species of birds thus far found to be commonly infected with *Plasmodium* sp. are, for the most part, among the most abundant of the Passeriformes. However, even more devastating in its effects on our bird population than disease has been the encroachment of human civilization. One of the chief factors resulting in the reduction of the avian population of North America has been drainage. An admirable review of this subject is being distributed by the National Association of Audubon Societies (Vogt, 1937).

Where drainage is being employed as a control measure and is proving injurious to the bird population it may often be that other methods of control could be utilized. Quite frequently drainage methods are resorted to as the easiest and least expensive approach as well as the most permanent means of control. Stocking ponds with certain larvivorous fish, changing the acidity of the water, fluctuation of the water-level, and other methods have at times proved to be adequate control measures. In such cases, where other methods are feasible, funds should be diverted to methods of mosquito-control which are *not* detrimental to wild life.

The previously-mentioned editorial in *Bird-Lore* also condemns the policies which allow one group to undertake large drainage projects while another group is creating large bodies of water. However, we must not lose sight of the fact that impounding of water, performed under proper supervision and with biological foresight, can create much better habitats for wild birds than might exist in many naturally occurring marshes or swamps, and can control mosquito-breeding as well. An excellent example is the Souris River project in North Dakota, where over an extended area flood-control and maintenance of breeding and feeding areas for the birds can be regulated and maintained under all conditions of weather. It is such projects as this that may be expected to maintain our bird population. Methods of mosquito control can be incorporated in these projects and thus the prevalence of avian *Plasmodium* can be lowered.

SUMMARY AND CONCLUSIONS

Malaria is a common infection in birds. Three genera occur in the red blood cells of the avifauna. *Plasmodium*, the genus which

also causes the malaria of humans, is very widespread among the avian species, and, at least in some species of birds, its prevalence is well over fifty per cent. While *Plasmodium* infections probably do not cause a high mortality in the birds, the disease tends greatly to lower the resistance of an infected individual and thus make it vulnerable to death from other diseases or natural enemies.

As in the human disease, *Plasmodium* infections of birds are transmitted by mosquitoes. The mosquitoes which transmit avian malaria differ from those which are the vectors of the human parasites. The mosquitoes which transmit one species of avian malaria may differ from those which transmit another species. A mosquito which serves as a vector of avian malaria in one locality may elsewhere prove immune to a different strain of the same species of parasite. Some of the mosquitoes which transmit avian malaria are among the most abundant pests of mankind; others may never attack man.

While it is true that the harm done by certain anti-mosquito projects (drainage) far overbalances the advantages to be gained by reducing the *Plasmodium* infections of birds, it is advisable that methods of mosquito-control which would not interfere with wild life but which would reduce both anopheline and culicine mosquitoes should be substituted. Research to devise further suitable methods of reducing mosquito population and decreasing avian malaria as well as the disease of man, without upsetting wild-life habitats, is much needed.

BIBLIOGRAPHY

Bird-Lore
1935—Vol. 37, p. 127.

Herman, C. M.
1938—The relative incidence of blood protozoa in some birds from Cape Cod. Trans. Amer. Micr. Soc. (In press).

Huff, Clay G.
1927—Studies on the infectivity of plasmodia of birds for mosquitoes, with special reference to the problem of immunity in the mosquito. Amer. Jour. Hyg. *7*: 706–734.

Manwell, R. D.
1935—How many species of avian malaria parasites are there? Amer. Jour. Trop. Med. *15*: 265–283.

Manwell, R. D. and Herman, C. M.
1935—The occurrence of the avian malaries in nature. Amer. Jour. Trop. Med. *15*:661–673.

Matheson, R.
1929—A Handbook of the Mosquitoes of North America. Thomas.

Novy, F. G. and MacNeal, W. J.
1904—Trypanosomes and bird malaria. Amer. Med. *8*: 932–934.

O'Roke, E. C.
1934—A malaria-like disease of ducks caused by *Leucocytozoon anatis*. Wickware. Univ. Mich. Sch. Forest. Publ. No. 4.

Vogt, W.
1937—Thirst on the land, a plea for water conservation for the benefit of man and wild life. Nat. Assoc. Audubon Soc. Cir. 32. 32 pp.

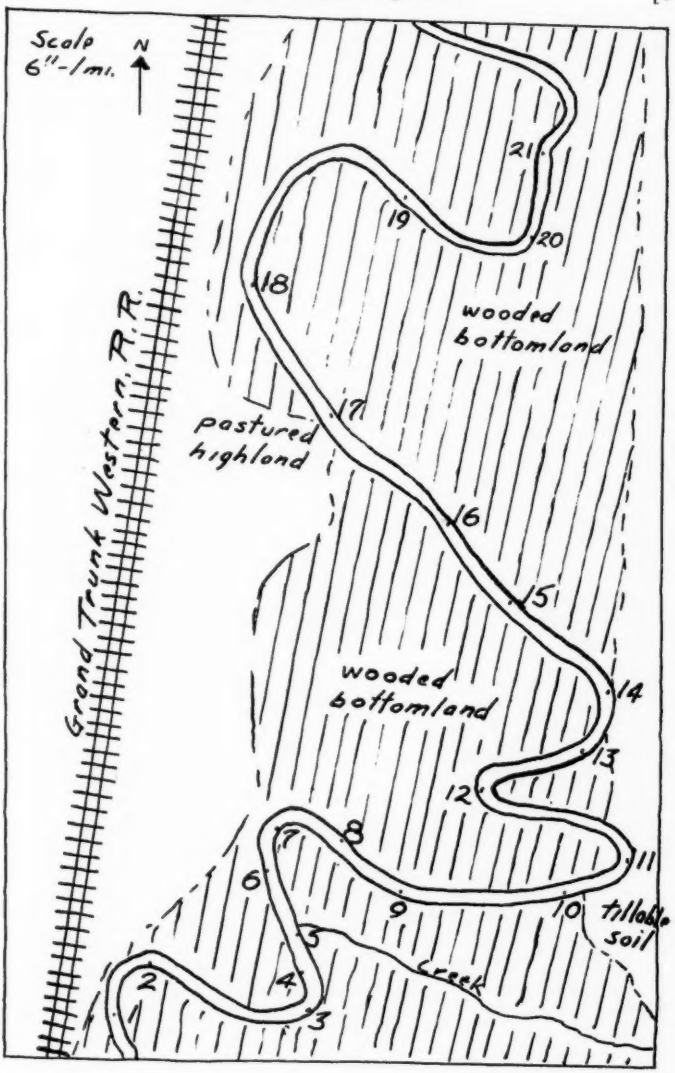
NESTING STUDIES OF THE PROTHONOTARY WARBLER

By LAWRENCE H. WALKINSHAW

Winding streams, bordered densely with oak, maple, ash, and elm, shallow ponds with groups of protruding willows and flooded, heavily shaded bottom-lands are favorite nesting habitats for the Prothonotary Warbler (*Protonotaria citrea*). Such habitats occur along the banks of the Kalamazoo River and its tributary the Battle Creek River in Calhoun County, Michigan.

During several years of observation, this species was found to be abundant during the breeding season in Convis Township, ten miles northeast of the city of Battle Creek, with the result that this area was selected for the study of the Prothonotary's nesting habits. Twenty-two bird-houses were erected on an area of between one and a quarter and one and three quarters miles in extent (see map). C. J. Henry and I had previously (in 1933) placed five nest-boxes along the Kalamazoo River west of Battle Creek and had spent much time in constructing them with the exception of one made merely by nailing a piece of bark around a round block of wood, then turning the top over a little on one side as a protection against rain. Of the five houses, the Prothonotaries had selected only this one as a nesting-site. During 1936, two houses made merely by nailing a few old boards together had proved attractive to the species when placed about two feet above the low-water river-level. These houses were in place before the winter months had raised the river to its accustomed higher level. By the first of May the flooded boxes were all again above the water level with the exception of box number 1, which had been washed out, another house which was destroyed during May by wood-cutters, and a third, number 13, which was never sufficiently above the water to be of any use. The following preliminary report deals with the nesting studies of the remaining nineteen houses during 1937 and the additional nests on or near this area. The accompanying map shows the situation of the houses in relation to one another.

From May 16th until July 3d, the hours from 5 to 7.45 A.M. were spent in a canoe along this area inspecting the contents of the nests and studying the behavior of the adults. In addition, every Thursday afternoon, every Sunday forenoon with few exceptions, and often Sunday afternoons were spent in the canoe or photographing from a blind. From July 4th through July 15th two young men, Wayne Tice and Carleton Akers, examined the few remaining nests. Twenty-one miles were driven by motor-car on each trip to this area, and an estimated four miles paddled by canoe. An approximate total of 1463 miles were driven merely to the area, without including several hundred-mile trips to study additional nest distribution in adjacent counties. An estimated 232 miles were paddled by canoe. Approximately 204 hours were spent



Battle Creek River, Convis Twp.,
Calhoun County, Michigan.
1937

studying the species during 1937 in addition to the many hours spent during previous years, especially during 1930 and 1933. At all times it was necessary to wear hip-boots, a heavy mackinaw, hat, and a neckerchief to keep away the hordes of mosquitoes. A set of Eastman Studio Scales graduated to one tenth of a gram were used in taking weights and a millimeter rule, dividers, and calipers for taking measurements.

The river, at the place where the study was made, was normally about one hundred feet across, having a variable depth, and many jams of old fallen trees. The banks were covered with a heavy growth of trees.

ARRIVAL DATES

The arrival dates of the first birds observed, during eight years, 1930-1937, and the last date of observation for each year follow:

Year	*First*	*Sex*	*Second*	*Common*	*Last*
1930	May 11	both	May 13	May 13	August 27
1931	May 10	male	May 14	May 16	August 16
1932	May 7	male	May 8	May 11	August 21
1933	April 30	male	May 2	May 14	September 4
1934	May 2	both	May 4	May 4	September 9
1935	May 11	male	May 12	May 12	
1936	May 6	both	May 7	May 9	July 30
1937	May 11[1]	male	May 15	May 16	July 25

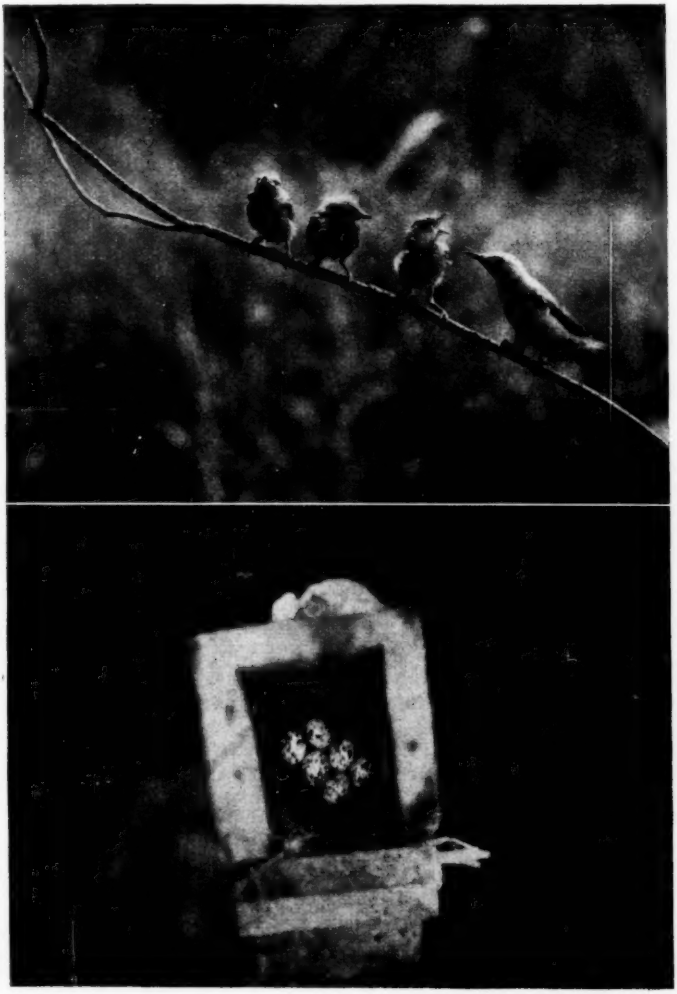
In spring observations the males are easily discovered because of their songs. The male Prothonotary Warbler certainly does not precede the female by many days. The earliest date for the arrival of the male was April 30th and that for the female May 2nd. Evidently the males are two or three days earlier. At Ann Arbor, Washtenaw County, seventy eight miles east of Battle Creek, in an area drained by the Huron River, the Prothonotary has been noted as much scarcer. Observations by Wood and Tinker (1934), covering a period of fifty years show April 11, 1916 as the earliest date. This is an exceptional date, their next earliest being May 8, 1896, when a pair was found nesting near Ann Arbor (Barrows, 1912).

Prothonotary Warblers, both males and females, do not become abundant, however, until May 10-15, when their voices can be heard from most any vantage point along the river, the males in song and both sexes with their sharp call-note. Almost immediately upon arrival the birds select their territories and nest-building begins.

SONG

The song of the Prothonotary Warbler is very distinctive, a rather loud *tweet-tweet-tweet-tweet-tweet*, uttered in the vicinity of the nest. The male usually has several perches from which the song is given.

[1] Observation by Mr. and Mrs. N. T. Peterson.



Upper Photograph: Male Prothonotary Warbler and Young
Lower Photograph: Nest and Eggs of the Prothonotary Warbler

Rather than definite singing-perches it is more accurate to say singing-trees or regions, for the male is a very active bird, and in guarding his territory he continually moves from one position to another in the vicinity of the nest, giving his song several times from each place. Usually these places are in certain definite trees or shrubs but not necessarily, as I have said, from definite perches. Yet on approaching the nest when feeding the female or young he usually follows through these trees with food in his mouth, uttering as he goes, the song which so enlivens these southern Michigan rivers. Uttered at the rate of five or six times per minute, the song lasts slightly over one second. It is given all day long from the time of arrival until the young have left the nest and has been heard as late as the 16th of August (1931). The frequency is much greater during the early nesting season and during the earlier hours. During midday on warmer days the number of times per hour seems much less. Later, from four until near sundown, it again increases. During late nesting, when the young are about to leave the nest, the rate again decreases, but it is heard several days after the young leave the nest. The songs of the various males differed somewhat. One male could be easily identified for some distance along the river. Another song, a flight song which I have never heard, has been described by Roberts (1932) as follows: "Now and then the male darts up above the tree-tops and, with drooping tail, fluttering wings, and head thrown back after the manner of the Maryland Yellow-throat, delivers a love-song consisting first of the usual rapid monotone of five or six notes and ending with a pleasing, varied warble, full and strong in some of its notes and far sweeter than the usual utterance."

The Prothonotary defends his territory with vicious flights at an opposing male or a bird of any other species that approaches too close. I have never seen any offender remain long after this procedure starts.

The call-note is a strong, sharp rather metallic *chip* resembling somewhat the call-note of the Louisiana Water-Thrush (*Seiurus motacilla*), which is also found along the same river-banks.

NESTING

Of the 28 nests found during 1937, 19 were in bird-houses over running water, 6 were in stubs over water, (2 of which were over running water), and the other 3 were in natural holes back from the river-bank. Of 44 nests found from 1930 through 1937, excluding the 21 in bird-houses, six were over running water in old woodpecker holes, one in a bridge-support in a slight depression, and nine in natural holes over standing water. Seven were in old woodpecker holes from two to a hundred and sixty feet back from the river-bank.

The height of the nests above the water varies considerably, especially with an increase in rainfall. The June rainfall during

1937 was 8.12 inches, the average for the past six years being 3.70 inches in June. Consequently rivers became swollen and bottomlands flooded. Once during a period of forty-eight hours in late June the river rose between fifty four and sixty inches. Such an increase, of course, was fatal to most of the low-nesting species in the area along the river, and the Prothonotary Warbler was no exception. Although the houses were examined each morning, occupied houses being continually shifted to two or three feet above the water-level, this sudden and extensive rise surprised us, and one morning every occupied bird-house was under water. Many parents returned as soon as the houses were raised above the water-level, and the eggs were incubated, but these eggs, with one exception, failed to hatch, the parents finally deserting the nests. Sixteen nests over water in natural stubs were from one to twelve feet up, averaging 5.6 feet, above the normal water-level. Seven nests over the land were situated from four to fifteen feet above the ground averaging 6.75 feet.

Moss constituted the bulk of the nesting material in nearly all cases, completely filling the nest space whether it was large or small. On top of this the nest proper was shaped and a rough lining of coarse grape-bark, dead leaves, black rootlets procured from the river-banks, and poison-ivy tendrils was added. Above this a lining of much finer rootlets, leaf-stems, and very fine grasses was used. The nest proper measured from 55 to 65 mm. in diameter at the top, averaging 59.3 mm. while the depth varied from 29 to 65 mm., averaging 42 mm. One nest with the whole front open, bordered by a wreath of poison-ivy vines and leaves, had a thickness of 50 mm. Another nest found in a similar stub, not protected at all above except by poison-ivy leaves, was merely a lining with a few coarse rootlets. Still another nest, built in a natural hole in a willow stub, had an entrance in a rotted section at least fifteen inches above the nest. The floor of the chamber was four or five inches across, and sunk to the rim in one corner was the neat nest of the Prothonotary, appearing much different from the regular type of nest.

The weight of six nests varied from 3.1 to 68.3 grams, averaging 28.6 grams. These weights were taken after the nests had been used. If one nest was destroyed, often when the same bird or another nested in that house the old material was left and the new nest constructed immediately over it.

Nesting during the years 1930-1937 began from the middle to the last of May and continued until late June or early July. The earliest nests each year were May 24, 1930, nest with three eggs; May 16, 1931, nest under construction; May 20, 1932, nest with four eggs; May 24, 1933, nest under construction and May 31, with six eggs; May 22, 1934, nest under construction; May 24, 1936, two nests, one with seven eggs, the other with six eggs; and May 16, 1937, four nests under construction. During 1937 the first eggs were

laid in eight nests as follows: May 22d, 23d, 23d, 25th, 26th, 28th, 29th and 31st. Nesting continued from May 16th until July 14th, when the young were destroyed in the last nest. This also was the latest nesting record of the species, and if the young had lived until fully fledged, they would have left the nest July 22d-23d.

The time required in the construction of nests varied, first nests requiring longer than second or third nests. During 1937 ten nests, evidently all the first constructed, required 7, 6, 11, 8, 2, 3, 2, 4, 6, and 4 days to build, averaging 5.3 days. These were listed from May 16th to 31st. Nine nests built during June, (probably all second nests but possibly one first nest) required 6, 1, 1, 1, 4, 1, 1, 1, and 1 days to build, averaging 1.8 days. However, these later nests often had some lining material added after one or two eggs were laid.

The female was observed to do most of the work usually, but males were occasionally observed carrying moss sometimes in green bulky mouthfuls to the nesting-site.

A resting period, after early nest-construction, varied from one to five days averaging nine nests, for 3.2 days. In case of later nests, as mentioned above, the first egg was laid almost invariably the day after the nest was started.

THE EGGS

The eggs of the Prothonotary Warbler as a rule are laid one each day until the set is complete. This is not always the case, however, for in 1937 nest No. 1 contained the first egg on May 23d and the second was not laid until May 26th, the third being laid on May 27th

The eggs are usually laid during the early morning hours. Nest No. 1 (nest-box 10), when visited May 27th at 5.30 A.M., contained only two eggs, but the female was flushed from the box, and when I returned at 7.00 A.M., it contained three eggs and the female was gone. In most nests this was the usual hour for deposition of the eggs, but occasionally, as in nest 5 (nest-box 12) twice the additional egg was found as early as 5.30 A.M. with the female still on the nest. Sometimes the female would enter the nest at this hour in the morning, but the nest would not contain an additional egg until the following morning. One female, at nest-box 16 (nest No. 11), when caught at 5.30 A.M. on June 5th, laid an egg in the canoe while I was banding her. Incubation evidently began the day before the last egg was laid, as in all cases on late afternoon observations no parent remained on the eggs at night until that time.

In three nests during 1937 Cowbirds' eggs were laid. In No. 1 (nest-box 10) one egg was laid on May 18th, four days before the first Prothonotary egg; in nest 5 (nest-box 12) one egg was laid the same morning as the first Prothonotary egg; and in No. 28, the nest contained, when found, one Cowbird egg, two Cowbirds three or four days old, one Prothonotary egg, and one runt Prothonotary young about two days old.

The exceedingly heavy rainfall during 1937, although taking

considerable toll of the young produced, brought out some interesting habits. On May 29th, when the water rose about two feet, two or three boxes were partially under water. These were immediately raised two or more feet above the water. Nest No. 3 (nest-box 2) had lost one egg (No. 2), but on the following morning at 6 A.M. it contained two additional eggs. Nest 5 (nest-box 12) was almost under water on May 28th, one day after the last egg was laid, and was the only flooded nest to later contain young when three hatched. If a nest had been under water more than twenty-four hours the birds immediately began another nest. If not, in every case but one they returned and continued incubating.

The eggs were white or nearly white in ground color, very glossy in all but two nests; these—nests 11 and 19 (boxes 16 and 19) —had sets of eggs very chalky and rough with very few dark spots.

HISTORIES OF BANDED RENESTING FEMALES, 1937

Band No.	*Nest No.*	*Nest Box*	*Nest Built*	*Eggs Laid*	*Eggs Hatched*	*Young Left*	*No. Eggs*
37-103950	12	natural hole		2 before May 30 May 30, 31, June 1	Destroyed June 4		5
37-103950	17	natural hole 20 feet from nest 12		Last egg June 12	Destroyed June 16		4
37-103949	5	12	May 18–21	May 22–27	June 10, 3 eggs	Destroyed June 13	6
37-103949	24	natural hole ¾ mile upstream		June 20, 21, 22	Deserted July 8		3
37-103948	9	21	May 21–25	May 29–June 3	June 14 (2 and 3) June 15 (4 and 5)	Destroyed June 15	6
37-103948	23	21	June 17–18	June 19	Destroyed June 19		1
37-103948	25	21	June 21		Nest box flooded June 22		
37-103947	2	7	May 16–27	June 1, 3, 4	Destroyed June 4		3
37-103947	22	6	June 14–16	June 17–21	Flooded June 22		5
37-103946	11	16	May 29–30	May 31, June 1–5	June 16 (2 and 4) June 17 (5)	Young drowned June 22	6
37-103946	27	16	June 27	June 27–30	July 12 (1, 2, 3)	Destroyed July 12	4
37-103945	10	8	May 23–31	June 3–7	Destroyed June 11		5
37-103945	20	8	Used same nest	June 15, 16, 17, 18 and 20	Flooded June 22 Deserted		5

The spots were also larger than normal. Usually the spots covered the entire egg and were reddish brown in color, often very fine and with a concentration around the larger end, but sometimes with a heavier wreath around the widest part of the egg. In some eggs only a few fainter lavender spots were noted. In one set of eggs (1937 nest 24) laid by female No. 37-103949, who had laid a normal-colored set in nest-box 12 (nest 5), the spots were much coarser and of a much lighter shade of reddish brown and were almost evenly splotched over the entire egg. Most sets were uniform in color, yet the same bird did not always have consecutive sets alike. No. 37-103946 (at nest-box 16, nests 11 and 27) laid a first set with a rough appearance. Later, after the young had been drowned in the nest on June 23d, this bird laid a second set in the same house June 27th to 30th which were perfectly normal in appearance. These are summarized in the table shown on page 39.

Five other females were banded, but they were observed at only one nest so are not included in the above list. No. 37-103944 was the only banded female to raise a brood during 1937. She evidently did not renest.

One notes in the above list that after a nest of eggs or young were destroyed there was only a short period before the first egg was laid in a new nest. These periods for the different birds ranged from 4 to 7 days. The number of eggs known to have been laid by these same females during the summer was respectively 9, 9, 7, 8, 10, and 10.

The sizes of the sets of eggs which have been recorded by months are as follows:

	May	*Early June*	*Late June*
3 eggs	none	none	2 sets
4 eggs	1 set	2 sets	1 set
5 eggs	1 set	4 sets	1 set
6 eggs	6 sets	1 set	none
7 eggs	2 sets	none	none
Average	5.9 eggs	4.8 eggs	3.75 eggs

The sets in May, including nests in which the first egg was laid on or before May 31st, are larger. The next classification included nests in which the first egg was laid before June 16th, while the third column includes nests in which the eggs were laid between June 16th and 30th. No nests were found in which eggs were laid in July.

The measurements of 78 eggs averaged 18.47 by 14.55 mm. The smallest of these was 17 by 13 mm.; the largest 20 by 15mm.; another measured 19 by 16 mm., giving the widest measurement. The average weight of 74 eggs taken when fresh was 2.07 grams, the heaviest being 2.35 grams and the lightest 1.2 grams. The weights of eleven eggs when fresh and at hatching time were as follows: Fresh weight (total) 21.5 grams; Weight at hatching time

(total) 18.2 grams; loss 3.3 grams, or 15.38 per cent loss during incubation.

INCUBATION

Incubation started in all nests the day before the laying of the last egg. It was performed entirely by the female. The male often came near the nest and made a faint *chip* that attracted the female, whereupon she would leave her nest-box to get insects that he brought her. At one nest he came to the entrance and fed her. In shallow nests she often peered out through the opening, but usually she was entirely out of sight and did not leave until something touched the entrance of the cavity.

Female Prothonotaries are easily caught while incubating, even if considerable noise is made in approaching the nest. They are very close sitters. However, if they have been once captured, they depart much quicker, leaving, sometimes, at the least swish of the canoe paddle. Some were not bothered in the least when caught; they were just as easy to catch the second time. When flushed from the nest the female usually began a persistent chipping. At one or two nests the bird leaving the house would flutter down and just above the surface of the water feigning injury until she reached the bank, where she would rise directly to a branch and start scolding.

Incubation required a period of thirteen days for eggs 1, 2, 3, 4, and 6 in nest No. 4 during 1937, and for egg No. 5 slightly over 13 days. For nest 9 the incubation period for eggs 2 and 3 was 13 days, while for eggs 4, 5, and 6 it was over 12 days. In nest 11, the incubation period for eggs 2, 4, and 5 was slightly under 13 days. At nest 27 the incubation period for eggs 1, 2, and 3 was 13 days. The incubation period of this species, as observed on these marked eggs, was between twelve and one-half and thirteen and one-half days, averaging for the 17 eggs about 12 days and 18 hours.

Out of a total of 36 eggs known not to have been flooded 34 hatched. During 1937, only 24 of 98 eggs hatched. Of these only 9 young lived to leave the nest, a very poor record chargeable mostly to the high-water conditions. A total of 123 eggs examined between 1930 and 1937, carefully checked, produced 41 young which is 33 percent. Of these, 26 lived to leave the nest.

THE YOUNG

The average weight of 16 young on the day of hatching was 1.84 grams. The average length of the wing was 6.24 mm.; the tarsus 5.55 mm., and the culmen 3.52 mm. The color of the skin was rather a slaty light gray with dark gray to nearly black natal down. When lying in the nest the young, early in life, have the head curled down underneath the body. They raise the head at the slightest noise and open the mouth for food. The eyes are closed, showing a prominent area of deep venous blue beneath the surface.

The average weight when one day old was 2.77 grams; average measurements of 13 young were: wing 8.05 mm., tarsus 7.23 mm.,

and culmen 4.0 mm. The primaries and secondaries showed through the skin in a dark line.

Average weight when two days old was 4.07 grams and average measurements of 10 young gave: wing 11.4 mm , longest primary 1.37 mm., tarsus 9.2 mm., and culmen 4.5 mm. In some of the young at this age the eyes were beginning to open. At this time the male does most of the feeding.

The average weight of 11 young when three days old was 6.05 grams. Measurements: wing 14.54 mm., longest primary 2.2 mm., tarsus 10.72 mm., culmen 5.18 mm. The eyes are now fully open and the feather-tracts well defined. The female now spends more time away from the young and aids the male much more with the feeding. Both parents remove excrement. At some nests they were observed to swallow it occasionally, at others to carry it off to some distant spot. This latter procedure was noted oftener as the birds became older. In approaching the nest the parents often followed a certain definite route; then, as they alighted near the nest-site, they peered about as though looking for enemies. When leaving they usually left direct for some distant spot. The food at this age was always small insects.

Average weight of 12 young when four days old was 7.91 grams, the measurements were: wing 20.83 mm., longest primary 5.3 mm., tail trace, tarsus 13.66 mm., culmen 6.16 mm. The color of the breast feathers now shows clearly.

Average weight of 12 young when five days old was 9.83 grams. The measurements were: wing 25.77 mm., longest primary 10.6 mm., tail 1.0 mm., tarsus 15.55 mm., culmen 6.72 mm. Feather-tracts well defined; the occipital, frontal, mid-dorsal, tail, scapular, humeral, primaries, secondaries, mid-throat regions are covered with slaty-gray sheathed feathers. The femoral region and an adjoining dorsal area are covered with mixed slaty-gray and yellow sheathed feathers. The ventral tract, extending in an inverted Y separates at the upper breast, changing from slaty-gray on the throat and upper breast to yellow on the two areas on the sides of the abdomen.

The average weight of 11 individuals when six days old was 11.6 grams. The measurements were: wing 30.75 mm., longest primary 15.8 mm., tail 2.41 mm., tarsus 17.25 mm., culmen 7.86 mm., and the longest primaries unsheathed 2 mm. Feathers on the tracts named above are longer.

The average weight of 9 individuals when seven days old was 12.29 grams. Measurements: wing 37.1 mm., longest primary 20.88 mm., tail (slightly unsheathed) 3.77 mm., tarsus 18.44 mm., and culmen 8 mm. Young show first slight signs of fear.

The average weight of 8 individuals when eight days old was 12.37 grams. Measurements: wing 42.0 mm., longest primary 25.87 mm., unsheathed 6.1 mm., tail 5.75 mm., unsheathed 1.0 mm., tarsus 18.99 mm., culmen 8.37 mm.

The average weight of 6 individuals when nine days old was 12.55

grams. Measurements: wing 45.3 mm., longest primary 30.1 mm., unsheathing primary 14 mm., tail 10.8 mm., unsheathing 1.3 mm., tarsus 19 mm., culmen 9.1 mm. A few birds left the nest at this age when disturbed. Feathers are well unsheathed.

The average weight of 3 individuals when ten days old was 12.06 grams. Measurements: wing 48.6 mm., longest primary 33 mm. unsheathed 19 mm., tail 12 mm., unsheathed 3.3 mm., tarsus unchanged, culmen, 9.5 mm. Young leave the nest at this age in nearly fifty per cent of cases and are able to fly about one hundred yards. In leaving the nest the young fly up towards the lower branches of the neighboring trees. One young at nest 4 when leaving the nest accidentally flew into the river and immediately began swimming toward shore. He used the wings in propelling himself and was able to cover the distance easily.

The weight of one individual when 11 days old was 12.7 grams. Measurements: wing 51 mm., longest primary 37 mm., unsheathed 21 mm., tail 14 mm., unsheathed 4 mm., tarsus unchanged, culmen 9.5 mm.

At this stage each day shows a more rapid development of the feathers. Unsheathed feathers extend out over the unfeathered tracts with a few of the dark mouse-gray natal feathers protruding above the occipital region.

Both the male and female fed the young as they left the nest. A faint chip made by the young from their perches was heard. Larger insects were fed when the young were out of the nest and the last few days in the nest. Once a male was observed to bring Mayflies, which he stripped of the wings before feeding them to the young.

The above data are summed up in the table following:

PROTHONOTARY WARBLER GROWTH RATE, 1937

No. of Individuals	*Age in Days*	*Weight in Grams*	*Wing in mm.*	*Longest Primary*	*Unsheathing of Primary*	*Tail*	*Unsheathing of Tail*	*Tarsus*	*Culmen*
16	1–	1.84	6.24	0	0	0	0	5.55	3.52
13	1–	2.77	8.05	0	0	0	0	7.23	4.0
10	2	4.07	11.4	1.37	0	0	0	9.2	4.5
11	3	6.05	14.54	2.2	0	0	0	10.72	5.18
12	4	7.91	20.83	5.3	0	.5	0	13.66	6.16
12	5	9.33	25.77	10.6	0	1	0	15.55	6.72
11	6	11.6	30.75	15.8	2	2.41	0	17.25	7.86
9	7	12.29	37.1	20.88	4.3	3.77	.5	18.44	8.0
8	8	12.37	42.0	25.87	6.1	5.75	1	18.99	8.37
6	9	12.55	45.3	30.1	14	10.8	1.3	19	9.1
3	10	12.06	48.6	33	19	12	3.3	19	9.5
1	11	12.7	51	37	21	14	4	19	9.5

The juvenal plumage has been well described by Roberts (1932). In general the young appear much different from their bright-colored parents, having a brownish color above and yellow below.

The parents feed the young at least two weeks after they leave the nest, and the small family groups can be found until the middle

of August during some years, evidently long after the young have left their nest. Whether the adults are in these flocks I cannot say.

The majority of the Prothonotaries leave our rivers by the second or third of July. One may canoe some years a good many miles during the latter part of July or the early part of August without finding a single Prothonotary, whereas in other years many groups can be found. The majority evidently are early migrants. Very few remain until late August or early September, the latest date being September 9, 1934, at Battle Creek. At Ann Arbor (Wood and Tinker, 1934) the only fall date was September 6, 1919, covering a period of twenty-five years, 1906–1930.

Eleven adult females were caught in making this study. The weights and measurements of ten are summarized as follows:

Number	*Date*	*Weight*	*Wing*	*Culmen*	*Tarsus*
103940	6–18	13.6 gr.	65 mm.	13 mm.	19 mm.
103941	6–16	17.6 "	70 "	15 "	18 "
103942	6–13	18.5 "	70 "	15 "	19 "
103943	6–10	19.6 "	69 "	13 "	19 "
103945	6–6	17.3 "	69 "	15 "	19 "
103946	6–5	16.4 "	70 "	13 "	18 "
103947	6–4	18.9 "	70 "	15 "	18 "
103948	6–1	19.0 "	65 "	13 "	18 "
103949	5–30	17.4 "	67 "	14 "	17 "
103950	5–31	15.8 "	71 "	13 "	18 "
Average		17.41 "	68.6 "	13.9 "	18.3 "

103944 escaped before weights and measurements were taken.

The males are very hard to catch at the nest. Instead of entering the nesting-box or cavity, they stand at the entrance, bending down and in to feed the female or young, occasionally raising themselves to peer about, then resuming the feeding. They do most of the feeding during the first two days after the young hatch, the female doing the brooding. In one nest with three young, two one day old and one just hatched, the male fed the young eight times during a period of two hours. The female, although occasionally leaving the nest for periods of one to twelve minutes, did not offer to feed the young. The male did not remove any excreta, but the female was noted to swallow some on one occasion.

At another nest, with six young just out of the nest, aged nine and ten days, the parents were observed for a period of four hours, the male feeding four young 38 times, the female feeding 2 young 10 times. She, however, was somewhat frightened by my presence.

In removing excreta from the nest, the male was observed to carry it in his beak to a place somewhat distant from the nest, flying as he did so in a slow, deliberate manner as though he had a heavy load.

Concerning the enemies of the Prothonotary Warbler during the breeding season, I have never actually seen any destroy a nest and

eggs or the young, yet out of 27 nests on the area studied during 1937, only two were productive. Seven nests failed because of high water. Four nests met with violent terminations as they were found torn to pieces. All four of these nests were on trees along the river-bank and possibly squirrels were the culprits. Seven destroyed nests had House Wrens nesting in the same box within three days, and almost invariably a male wren was singing at the box when the eggs were gone. On several occasions a pair of House Wrens had begun building over an unfinished nest of the Prothonotary Warbler, but when it was next visited the Prothonotaries would be back in possession. Such nests met with failure in every case, the eggs usually disappearing during laying time when left unguarded. In two nests the eggs disappeared and the nest left intact but in these cases also House Wrens may have been responsible. One was in a nest-box on a pole extending out over the river, fifteen feet from the bank. Nothing could climb to it from the water, and the offender must have come by flying. Two other nests were in a neighborhood where English Sparrows were abundant.

SUMMARY

The Prothonotary Warbler nests rather abundantly along southwestern-Michigan rivers. Ten or eleven pairs nested on an area of one and one-quarter to one and three-quarter miles in extent during 1937. Nineteen out of twenty-eight nests were in bird-houses. They prefer nesting over running water wherever possible.

Construction of nests in May required an average of 5.3 days for 10 nests; later (June) nine nests averaged 1.8 days. Both parents help, the female doing by far the most of the work. Rest periods for nine May nests averaged 3.2 days. In later nests, the first egg was invariably laid the day following the beginning of its construction.

The eggs were laid usually before 7.30 A.M. daily until the set was complete. They were white or chalky-white, covered with reddish-brown and a few lavender spots. Ten sets averaged 5.9 eggs during May; seven sets (June 1–15) averaged 4.8 eggs; four sets (June 16–30) averaged 3.75 eggs. No nests were found in which eggs were laid in July. The rest periods between destroyed nests and the first-laid egg in the succeeding nesting for five females ranged between 4 and 7 days, averaging 5 days. Average egg measurements were 18.47 by 14.55 mm. Seventy-four newly laid eggs averaged in weight 2.07 grams. Incubation started the day before the laying of the last egg and was performed entirely by the female. The incubation period for 17 eggs averaged between twelve and one-half and thirteen and one-half days.

During 8 years of observation out of 123 eggs, 41 hatched (33 per cent) and 26 young left the nest (21.14 per cent of the eggs).

The average weight of 16 young newly hatched was 1.84 grams; that of 3 young ten days old, 12.06 grams, and 1 young eleven days

old, 12.7 grams. Most of the young left the nest when 10 days old, but some not until 11 days of age.

The female broods the young for two or more days while the male feeds them almost entirely. Later both parents feed them until they have been out of the nest at least a week.

The majority of the Prothonotaries leave for the South during late July or early August, a few sometimes remaining until early September.

Ten females averaged in weight 17.41 grams (13.6 to 19.6). No males were weighed.

BIBLIOGRAPHY

BARROWS, WALTER B.
Michigan Bird Life. Special Bull. Michigan Agric. College, pp. 581–582. 1912.

ROBERTS, THOMAS S.
The Birds of Minnesota. Minneapolis, vol. 2, pp. 189–193. 1932.

WOOD, NORMAN A. AND TINKER, A. D.
Fifty Years of Bird Migration in the Ann Arbor Region of Michigan. *Occ. Papers Mus. Zool. Univ. Michigan*, No. 280, 56 pp. 1934.

Battle Creek, Michigan.

DETERMINING SEX IN BREEDING BIRDS[1]

By EDWIN A. MASON

THE value and importance of being able to determine the sex of banded birds is obvious to all coöperators. When the sexes are dissimilar in plumage, no difficulty arises, but with those species in which the plumage of the two sexes are always, or at times, alike, a real difficulty presents itself.

Through handling many adult breeding birds over a long period, and actuated by the thought that there must be some differences between the sexes, however slight, the writer eventually formulated a system which has decided values in determining sex.

Feeling that perhaps this discovery was not new, although no reference to the ability of being able to determine sex in living birds except by plumage and measurements had ever come to the writer's attention, the subject has been broached on many occasions to workers in the banding field. Among those with whom the subject has been discussed, only Mr. James L. Peters, of the Harvard Museum of Comparative Zoölogy, indicated having a prior knowledge of the subject, and it is desired here to acknowledge the helpful criticisms and suggestions made by Mr. Peters during the preparation of this paper.

It is, therefore, in the hope of bringing the matter to the attention

[1] A contribution from the Wharton Bird-Banding Station, Groton, Massachusetts.

of greater numbers of bird-banders that this brief description of the external physical differences between the sexes when they are sexually active, and upon which the determinations can be based, is given.

The problem of determining sex in living birds is one that has arisen with the comparatively new technique of banding the live bird, and so probably received little or no attention from ornithologists in the past. A reference to male organs of generation made by Coues shows that these outward characteristics of the sexual parts during their period of sexual activity were known, but when working with dead specimens sexing naturally was accomplished by the more positive method of making an internal examination. The remarks made by Coues in his "Key to North American Birds," (Fourth Revised Edition p. 218), to which reference has just been made, refer to the male organs; he says: "These papillose terminations of the sperm-ducts are erectile to a degree, and answer the purpose of paired penes in those birds which are not provided with better-formed copulatory parts. *In coitu*, the cloacal chambers containing the orifices of the genital ducts are opened, and the more or less protruded papillæ come in contact or close juxtaposition."

Too much emphasis cannot be laid on the limitations of the system, however. These are two: (1) The system only has value during the period when the birds are sexually active; (2) it is not applicable with equal value to all species and all individuals, and seems to work best when applied to members of the Family *Fringillidæ*. It might be added that a limited experience indicates that Robins (*Turdus m. migratorius*) and Redstarts (*Setophaga ruticilla*), are two species outside the Finch Family that can be sexed by this system. It is hoped that other banders will attempt the application of the system to any species that comes to hand during the breeding season, in order that it may be possible ultimately to round out the knowledge of the species to which this method of determining sex can be applied. Examinations of the cloacal regions of birds of known sex would be extremely helpful to anyone seeking to build up an experience in the application of the system. A puff of breath properly directed will usually expose the parts to be examined, and is a more desirable method than exposing these delicate organs with the fingers and, by so doing, running the risk of injury to them.

It is well known, of course, that the period of reproductive activity in birds is marked by internal physical changes. In the male the gonads become greatly enlarged, and in the female the ovary increases in size as the ova ripen before actually breaking off from the mass to make their individual journeys that end with the depositing of the completed egg. Careful observation and a little experience will enable anyone to note that the ventral parts also of some birds at this season take on a changed form as they prepare for their

reproductive functions, and it is on these physical differences that sex determinations in the live bird can be based. In the simplest terms, and at the height of the reproductive cycle, they can be described as follows:

MALES: The cloacal region will be found to be in the form of a bulbous protuberance.

FEMALES: The cloacal region tapers off gradually to the vent, and the orifice itself often will be found to be dilated.

The following records taken at random are illustrative of the value of the method, particularly if breeding census work is being undertaken:

Eastern Purple Finch (*Carpodacus p. purpureus*) L32919, banded July 18, 1934, sex determined as young male, plumage fairly strong olivaceous. This bird was subsequently taken in the rosy plumage on July 2, 1935, and June 20, 1936.

Eastern Purple Finch 34-49122, banded June 22, 1935, sex determined as young male, plumage strongly olivaceous. The determination was verified on May 26, 1936, when the bird returned in the rosy plumage.

Eastern Purple Finch 36-61524, banded June 18, 1936, sexed as female, had plumage moderately olivaceous. On July 2, 1937, this bird was again trapped, and again sexed as female.

American Redstart (*Setophaga ruticilla*) 37-12856, banded June 1, 1937, and sex determined as female, repeated on July 5th, July 23d, and August 2d. On the latter date the plumage bore out the earlier sex-determination. (Dwight, *Annals N. Y. Acad. Sci.*, Vol. XIII, No. 1, pp. 1-72, July 18, 1900, referring to the Redstart, says: "Adult winter plumage acquired by a complete postnuptial moult in July.")

To repeat a previously made warning statement, the above system of determining sex has decided values, but not all individuals, even during the nesting season, can definitely be sexed by it. Such birds as clearly conform can be sexed safely, but whenever there is the least doubt, the system should not be pushed—the bird should be released as "sex undetermined."

THE EASTERN HAIRY WOODPECKER (*Dryobates v. villosus*) AS A MIGRANT

By LEWIS O. SHELLEY

IN none of the ornithological literature at my disposal have I seen any reference to the Eastern Hairy Woodpecker as a migratory species, in the sense that it migrates in a similar manner to other migratory species. The A. O. U. Check-List (Fourth Edition) does not mention any migration taking place among any race of Hairies.

In this connection I should like to present some data obtained from observations in East Westmoreland, southwestern New Hampshire. The data submitted cover the period from 1930 to 1935.

In the fall of 1930 it was apparent that there was an autumn increase of Hairies as the birds were almost common during the period from early September (mid-August in 1933) to mid-November, their number reaching a maximum in October. As a rule this species occurs near my home as a single pair having a territory as breeding birds of approximately three-fourths of a mile across. It has also been apparent that Hairies in winter occur as single birds, each male and female occupying a single territory, except that at my feeding station, both sexes are daily visitors throughout the year. Knowledge of the Hairy's distribution during the autumn and winter months has resulted from my being habitually much in the woods and covering a large area during the winter.

During the period above mentioned each fall a movement of Hairies moving southwesterly was easily observed. Coming from the direction of Wessley's Hill on the northeast, they pass by (often fanwise from this hill) toward White and Owl Hills to the southwestward. The distance separating the crests of Wessley's and White Hills is approximately two miles. I have with binoculars many times watched the passage of Hairies over this route between the hills and also at a lower altitude over the valley in which the village nestles. Some birds drop down when reaching the crest of Wessley's Hill and, on entering the woodlands appear to feed as they pass through; others cover the distance in a non-stop flight, at various heights above the tree-tops. They are often heard giving their loud call uttered at the low point in their undulating flight.

In this connection it is interesting to note that Frank M. Chapman mentions that Hairies are more common about Washington, D. C., in winter than in summer. (See the second revised edition of "Birds of Eastern North America," 1932, page 359).

The number of birds seen or heard passing through Westmoreland in a single day may seem small to be classed a migratory movement, but a count at the end of several weeks is surprising. Some days no birds were noted but on other days from one to as many as six were seen. The actual number would be even greater if the birds flying directly over my station and the ones passing more slowly through the woodlands could be seen and counted. In three years, passing Hairies were observed as follows: the first positive 1932 bird was seen and heard flying low on September 7th, and the last was seen on October 15th. One was seen migrating on August 3, 1933—an extremely early date—and the last bird in October. In 1934 a bird was seen September 20th, the last one on October 24th. It was not until this date, October 24, 1934, that I chanced to see what might in reality be classed as a mass movement, a movement which convinced me that this autumn increase of Hairies was, indeed, an actual migration. On this date beginning soon after noon, and

lasting until four o'clock, the birds continued to pass through. At least twelve birds were seen as I walked up a dirt roadway parallel to the course the birds were taking. Other moving Hairies were heard but how many actually were present was undetermined. At one time, when some two hundred yards of mowing and pasture land with some small trees in the borders and brush-growths in bisecting hedgerows was within good view, it was noticed that the birds were spaced from forty to fifty yards apart, keeping along at this distance and abreast of one another. As they approached a rock-maple woods the tendency was to close in nearer together like passing through the neck of a bottle and, once through the woods, again to spread out. Their progress was rather fast, the birds flying from tree to tree, stump or a stub.

I followed and watched in particular a male that continued keeping along nearby but always ahead of me. He would visit one tree, take a turn or two around the trunk or along a branch, stopping to look around, and then drop down to the next point of passage. Once when he flew across the road to a low stump, instead of using the normal bounding flight he resorted to the fast wing-fluttering phase, accompanying it with the chittered call—both of which were a part of the spring mating behavior. He repeatedly crossed the road in a zigzag manner. Climbing to the top of a fence-post or stump, he lingered, probably noting the progress of the other birds and often answering their ringing calls. He, as well as the other birds when seen nearby, gave the appearance of a stranger in a new environment. More time was spent by these birds in looking around and random flying as they advanced than in feeding, and little and often no food was seen to be gleaned in a distance of some sixty yards covered. Their examinations of bark crevices were desultory and hasty. I noted with acute interest how low the birds were passing, quite frequently flying as low as four feet or less from the ground over open spaces where long, bounding flights were made.

Three birds, a female and two males, measured in the course of this study were typical *villosus* in measurements.

If the Hairy Woodpecker shows a migratory trend in this locality, why not elsewhere?

FIRST SIGHT-RECOVERIES OF MARKED HERRING GULLS

By J. J. HICKEY AND ROBERT P. ALLEN

BECAUSE the Herring Gull project is such a unique experiment in field coöperation, it seems necessary that migration watchers be given an early analysis of its operation. The measures by which these gulls (*Larus argentatus smithsonianus*) were marked with celluloid bands have already been described in *Bird-Banding* (VIII: 73-5; 126; 173). More recently the McMillan expedition reports that it was unable to ring any birds in Labrador, thus setting the final figure of banded birds in 1937 at 6,140.

The red, blue and yellow colors which were used, are fairly conspicuous in the field. Most of the bands carried by the birds rest close down to the foot. Combinations are clearly read at from fifty to seventy-five yards, but this varies with the circumstances of the observation and with the magnifying power of one's binoculars. Birds following a fishing boat occasionally permit an observer to read quite accurately the order of colors without the aid of a glass, but under ordinary conditions the exact color of combinations cannot be clearly ascertained on birds in flight. Most of the aluminum bands bearing the customary inscription of the U. S. Biological Survey are so invisible in the field that their position can only be seen with great difficulty. These metal bands do not constitute an essential part of the color combinations used in 1937. They do, however, serve as a check on the possibility of bands slipping or breaking off.

The number of sight-recoveries accepted as bona fide by the Field Work Committee of the Linnæan Society of New York, numbers 135 at this writing, December 14th. These were reported by 29 persons, of which 71 per cent are known to be bird students. This latter group however, actually contributed more than 84 per cent of the recoveries recorded. It seems apparent that further assistance from laymen in this project will only be obtained by repeated releases of publicity to the press. This ideal can only be imperfectly achieved due to the amateur character of the project.

In the accompanying table No. 1 the writers have omitted the exact localities in which the sight-recoveries were made. The records all come from the coast, and the resultant picture, at least for New York, indicates the complicated movement of the gulls southward. St. Mary Islands lie on the north shore of the Gulf of St. Lawrence, Bonaventure lies on the south shore, and the Razades are in the St. Lawrence River, not far from the city of Quebec. Previous recoveries of birds banded only with the metal rings of the Survey have shown that the wintering grounds of these gulls tend to include Newfoundland and the maritime provinces rather

than the states to the south. The records of these birds on Long Island (N. Y.) comes therefore as something of a surprise.

TABLE NO. 1

The meanings of the exponents 1–5 added to the names of the coöperators are as follows: [1] Bird was shot, [2] Adult bird, [3] Bird was captured, [4] Same bird captured and released, [5] Dead bird.

St. Mary Islands, P. Q.	Razades Islands, P. Q.	Bonaventure Island, P. Q.
NEWFOUNDLAND		
	Sept. 8—E. Hann[2]	
MAINE		
	2–Oct. 27—C. D. Wallace	
NEW YORK		
Oct. 12—A. D. Cruickshank	Oct. 22—A. D. Cruickshank	Oct. 22—Cruickshank
	Oct. 30—H. Kraslow	
Nov. 11—Mr. & Mrs. Boerher	Nov. 11—Brigham, Herbert, Hickey	Nov. 11—Herbert, Hickey
	2–Nov. 16—H. Kraslow	
	2–Nov. 20—H. Kraslow	
	Dec. 4—Allen, Painter, Flynn, Hickey	
2–Dec. 11—Kraslow, Jacobson, Painter, Shainin	Dec. 11—Kraslow, Jacobson, Painter, Shainin	

Kent's Island, N. B.	Muscongus Bay, Me.	Heron Island, Me.
MAINE		
6–Sept. 1—N. R. Pillsbury		Aug. —Cruickshank
4–Oct. 27—C. D. Wallace		Aug. —Cruickshank
NEW HAMPSHIRE		
Nov. 4—E. M. Lailer		
Oct. 24—E. J. DaVerger		
MASSACHUSETTS		
Nov. 28—R. Batchelder		Nov. 3—C. W. Buchheister
RHODE ISLAND		
Nov. 20—H. N. Hobbs		
CONNECTICUT		
Nov. 1—C. P. Smith		Oct. 22—C. P. Smith
4–Nov. 5—C. P. Smith		
NEW YORK		
Oct. 3—A. A. McDonald	Sept. 26—J. Peachman[5]	
Oct. 7—J. F. Kieran	Oct. 8—J. F. Kieran	
Oct. 10—R. Christensen	3–Oct. 10—Cruickshank	2–Oct. 10—R. Christensen
2–Oct. 17—V. Shainin, Allen, Cruickshank	2–Oct. 12—Cruickshank Oct. 17—Allen, Cruickshank	Oct. 16—C. Hastava
Oct. 22—Cruickshank		
2–Oct. 23—H. Kraslow		
Oct. 30—H. Kraslow		3–Oct. 30—H. Kraslow
Oct. 31—Cruickshank	Oct. 31—Allen, Cruickshank, Hickey	Oct. 31—Cruickshank
Nov. 6—H. Kraslow		
Nov. 7—R. A. Herbert		
5–Nov. 11—Herbert, Hickey	Nov. 11—Herbert, Hickey	Nov. 11—Herbert, Hickey
2–Nov. 16—H. Kraslow		
3–Nov. 20—H. Kraslow		
Nov. 21—J. J. Hickey	Nov. 21—J. J. Hickey	Nov. 21—H. Kraslow[4]
Nov. 22—H. Kraslow	Nov. 22—H. Kraslow	2–Nov. 26—Flynn, Kraslow
3–Dec. 4—Allen, Hickey		Dec. 4—Allen, Hickey
2–Dec. 5—Allyn, Brooks, Hickey, Woodbridge		
2–Dec. 11—J. J. Hickey		
5–Dec. 11—Kraslow, Jacobson, Painter, Shainin		Dec. 11—Kraslow, Jacobson, Painter, Shainin
NEW JERSEY		
Nov. 21—J. M. Cadbury	Sept. 26—J. M. Cadbury	
Nov. 21—J. M. Cadbury[2]	2–Nov. 21—J. M. Cadbury	

Isles of Shoals, N. H.	Penikese Island, Mass.	Wicopesset Island, N. Y.
NOVA SCOTIA		
Sept. 18—E. S. Fanning[5]		
NEW HAMPSHIRE		
Aug. 20—R. Reid[4]		
MASSACHUSETTS		
Sept. 1-3—Smith, Speck[4]	Nov. (10?)—J. J. Fraser	
Sept. 7—E. Snow[4]		
Sept. 9—S. Parsi[4]		

NEW YORK
4–Sept. 12—Miss M. Kinney
Oct. 8—J. F. Kieran
Oct. 9—R. G. Kramer
Oct. 10—Cruickshank
Oct. 12—Cruickshank
Nov. 16—H. Kraslow
2–Nov. 20—H. Kraslow
Nov. 26—Flynn, Kraslow

Oct. 7—J. F. Kieran

3–Nov. 20—H. Kraslow
Nov. 26—Flynn, Kraslow
Dec. 4—J. J. Hickey

Oct. 15—C. Hastava
2–Oct. 23—H. Kraslow
Nov. 11—Herbert, Hickey
Nov. 21—J. J. Hickey

NEW JERSEY
Nov. 21—J. M. Cadbury

Sept. 26—J. M. Cadbury

MARYLAND

Aug. 24—E. F. Fadum[5]

These recoveries offer but a glimpse into the migratory movements of the Herring Gulls. Since over 65 per cent of the reports came from New York, it may be well to summarize the data from that area as follows:

TABLE NO. 2

95 RECOVERIES IN THE REGION OF NEW YORK CITY

(Colonies, reading from left to right, are arranged from north to south)

	St. Mary's	*Razades*	*Bonaventure*	*Kent's*	*Musongus*	*Heron*	*Shoals*	*Penikese*	*Wicopesset*	
Sept. 1–30.....	–	–	–	–	–	–	4	–	–	4
Oct. 1–15.....	1	–	–	3	5	2	4	1	1	17
Oct. 16–31.....	–	2	1	7	2	6	–	–	1	19
Nov. 1–15.....	1	1	1	7	1	1	–	–	1	13
Nov. 16–30.....	–	4	–	7	3	1	4	2	1	22
Dec. 1–11.....	2	2	–	12	–	3	–	1	–	20
	4	9	2	36	11	13	12	4	4	95

Just how may one deliberately set out to find banded gulls? The answer to this question may possibly vary from one locality to another. The writers' knowledge of daily habits of fall and winter gulls is confined largely to the vicinity of southern New York State. There the birds flock into great rafts near nightfall. The position of these roosts always varies according to winds, the birds endeavoring to find the most sheltered water in the bays. Diurnal concentrations occur at garbage dumps on the outskirts of the large cities where the gulls feed about forty-five minutes after sunrise. Feeding on the dumps is intermittent and is broken by long periods of resting on adjacent areas,—marsh, tidal flats, fields, rivers, piers, etc. These resting areas may make the observation of colored bands comparatively easy or utterly impossible. At the present time 55 per cent of the sight-recoveries come from garbage dumps, 4 per cent from the resting areas nearby, 13 per cent from fishing boats and piers, 4 per cent from beaches, 5 per cent from miscellaneous places and 16 per cent from places unknown to the committee.

One of the most fascinating aspects of migration watching this fall has been an endeavor to determine the ratio of banded to unbanded first-year gulls. During October and November, this ratio was usually from 1:50 to 1:100 on Long Island. If in some future year comparable observations can be obtained at a number of other points along the eastern flyway of this species, we may be able to secure a satisfactory index of the major part of the Herring Gull population.

SUMMARY

1. Successful observation of colored band combinations on Herring Gulls varies with the power of binoculars and with local conditions.

2. Bird students have contributed 84 per cent of all sight recoveries (up to about December 12, 1937).

3. The migration of first-year Herring Gulls southward appears to be fairly complicated. Birds from the St. Lawrence River and Gulf, and the Bay of Fundy, reach Long Island and New York City shortly after the Maine Coast Gulls arrive. Recoveries are insufficient as yet to permit a complete analysis of these movements.

4. In the New York City region a majority of recoveries have been made on garbage dumps, and successful observation has depended on some knowledge of the habits of local gull flocks.

BIBLIOGRAPHY

EATON, R. J.
"The Migratory Movements of Certain Colonies of Herring Gulls in Eastern North America." *Bird-Banding*, IV: 165–176 (1933); V: 1–19; 70–84 (1934).

GENERAL NOTES

Some Detailed History of Herring Gull 37-652822.—From the five hundred young Herring Gulls (*Larus argentatus smithsonianus*) banded at the Isles of Shoals, New Hampshire, in July, 1937, one bird has already been identified several times by means of the colored bands.

This gull was raised as a campus pet at the Summer school of the University of New Hampshire at the Isles of Shoals. It was not confined at any time.

On August 28, 1937, this bird was first identified at Rye North Beach, New Hampshire near the place of banding. It was on the ground, where it was stretching its neck and calling, acting as though it was trying to swallow something but was unable to do so. The discoverer walked to the bird and was surprised in being allowed to pick it up. The bird's throat was stroked, in an effort to correct the trouble. The bird soon became quiet and stopped calling. It was then tossed into the air that it might fly away, but it rose only about twenty feet, making a circle, and alighted at the captor's feet. It was then taken out on some low rocks by the seashore, where it was left. Soon another gull swooped down near it, giving a call, and both flew away together.

At its next place of recovery, 37-652822 became well known. Here, in Ipswich Bay, Massachusetts, many fishermen learned to await its appearance, catching it easily when it alighted on their fishing-boats. The fishermen fed it sand-worms, sand-eels, fish-bait, and fish-refuse. It could be easily caught, and would take food from the hands of the mackerel fishermen readily and fearlessly. It remained at least through the 3d of September. It was also reported a mile and a half east of Plum Island.

This gull was next reported from Gloucester, Massachusetts, at Pavalion Beach. Its tameness was continued here, where, the last time heard from, it followed its captor about the beach for an hour or so, while he worked on his boat. When released on September 9th it still wore its conspicuous bands, two of red celluloid and a numbered aluminun band. No report has been received since the bird was last seen at Gloucester on the above date, when it was observed as it flew away.

At the Isles of Shoals 37-652822 began early in August to fly down to the ocean, coming back to the laboratory building at night, never leaving the immediate

vicinity of the building, save for its forays to the water, where it was observed several times feeding with the wild gulls of the vicinity.—Lewis O. Shelley, East Westmoreland, New Hampshire.

A Pair of White-breasted Nuthatches Mated for two Winter Seasons.—On October 25, 1937, I trapped a female White-breasted Nuthatch (*Sitta-carolinensis*) bearing band 194226. Five days later (October 30, 1937) I trapped a male bearing band 194229. Both of these birds have since repeated several times and are to be seen together almost constantly nearly every day (December 11th).

The female was originally banded by Ralph W. Goodale on November 21, 1936, and five days later (November 26, 1936) he also banded the male bird. Both were banded at his station which is less than a mile distant from my own.

Although the fact that the female preceded the male to the trap by five days in each instance is probably only an interesting coincidence, it is quite evident that we have here two birds which have been closely associated, possibly as mates, for almost a year.—G. Hapgood Parks, 141 Branford Street, Hartford, Connecticut.

RECENT LITERATURE

(Reviews by Margaret M. Nice and Thomas T. McCabe)

The articles have been selected and arranged under subjects of importance to students of the living bird, and also for the purpose of suggesting problems, or aspects of problems, to those banders who wish to make the most of their unique opportunities.

Headings in quotation marks are the exact titles of articles or literal translations of such titles. Except in the case of books, which are always reviewed under their titles, headings not in quotation marks refer to general subjects, or are abbreviated from titles in foreign languages. References to periodicals are given in italics. Reviews by Mr. McCabe are signed with his initials.

MIGRATION STUDIES

"Physiology of the Migration Drive."[1]—Discussion of migratory restlessness in relation to metabolism based on experiments on Whitethroats (*Sylvia communis*) and Redbreasts (*Erithacus rubecula*) in Breslau. The author believes the migratory urge is due to increased thyroid secretion. His birds showed restlessness only after they had reached a maximum weight; it disappeared after they had lost weight, but reappeared when they had gained weight. This is a matter on which banders can give us information by weighing their birds; the native sparrows that I have caught did not show high weight in the fall, nor did White-throated Sparrows (*Zonotrichia albicollis*) gain weight during stays of five to twenty-six days.

"Release of Spring Migration Restlessness through Warmth in Caged Redbreasts, *Erithacus rubecula* (L.)."[2]—On March 21st the temperature was reduced to 5° C., then raised on March 30th to 20° C.; lowered on April 3d and raised again April 6th. The sudden warming of the room brought on migration restlessness in all the birds.

"The Migration of Birds."[3]—A review of recent theories. M. Dupond disagrees with the ideas of Stimmelmayr and Cathelin, but quotes with approval Wachs and Rowan. On the subject of "way-finding" he mentions the notable experiments of Rüppell and Stresemann. He criticizes the glacial theory of the origin of migration, believing that life originated near the equator and spread to the north, the cold of winter causing a yearly retreat in the case of the birds. He cites Mayr's study of the Serin (*Serinus canarius serinus*), a permanent

resident along the Mediterranean, that has extended its range over much of central Europe since 1800; as it spread to the north it became migratory.

"The Irregular Migrations of the Crossbill, *Loxia c. curvirostra*, and their Relation to the Cone-crop of the Conifers."—A. Reinikainen. 1937. *Ornis Fennica*, 14:55–64. Censuses of breeding pairs of the Red Crossbill in Finland in March over one hundred twenty square kilometers showed striking agreement between the crop of spruce seeds and the number of birds, but no agreement with the crop of pine seeds. The birds breed wherever there is a rich cone crop, then wander to find another. "Two rich cone-crops seldom occur in exactly the same region in subsequent years."

"Banding Results on Central European Barn Owls (*Tyto alba guttata* Brehm.)"[4]—A résumé of 419 retakes of birds banded in Germany. Young birds wander in all directions, having been taken from 20 to 754 kilometers from their birthplaces, but there is no real migration. The adult birds are fairly stationary. Of two birds from the same brood one was killed in north Denmark, the other in central France. An owl only three-fourths of a year old was found incubating eight eggs. One pair were permanent mates from 1921 till their death in the severe winter of 1928–29. The chief causes of mortality were an epidemic of coccidiosis, starvation in 1928–29, shooting, overhead wires, and drowning in water-containers. The greatest age reached was nearly nine years. Of 97 Barn Owls banded by the author no less than 36 were taken.

"Migratory Behavior of Some Glaucous-winged Gulls in the Strait of Georgia, British Columbia." —G. D. Sprot. 1937. *Condor*, 39:238–242. Immature *Larus glaucescens* disperse in different directions in autumn and apparently stay in certain localities. "Minor territorial rights" are shown; a bird may claim a small craft and guard it "against all comers." "Should the boat put to sea for several months, on its return to the harbor it will often instantly be boarded by the same bird." The author stresses the value of color-banding.

[1] Merkel, F. W. 1937. Zur Physiologie des Vogelzugtriebes. *Zoologischer Anzeiger*, 117: 297–308.

[2] Palmgren, P. 1937. Auslösung der Frülingszugunruhe durch Wärme bei gekäfigten Rotkelchen, *Erithacus rubecula* (L.). *Ornis Fennica*, 14:71–73.

[3] Dupond, Ch. 1937. La Migration des Oiseaux. Extrait d' "*Ornithologie*." No. 110:562–568, No. 111:577–584, No. 112:585–588.

[4] Schneider, W. 1937. Beringungs-Ergebnisse an der mitteleuropäischen Schleiereule (*Tyto alba guttata* Brehm). *Der Vogelzug*, 8:159–170.

LIFE HISTORY

"Life History of the Oven-bird in Southern Michigan."—H. W. Hann. 1937. *Wilson Bulletin*, 49:145-237.

An outstanding example of conscientious, well-planned work, in which the latest techniques were employed—colored bands, weighing-machine, blinds, and itograph. Besides being a detailed study extending over three years on the life-history of *Seiurus aurocapillus*, the paper records much important information concerning the Cowbird (*Molothrus a. ater*). The only criticism that I have to offer is that Dr. Hann devotes too much space to quoting from the work of others, and hardly does justice to the unique value of his own findings. This is particularly true in two subjects—the relation of temperature to arrival in the spring and to the start of nesting, and the incubation rhythm. Figure 4 on p. 227 shows beautifully how temperature above normal brought the birds early—April 28th and 29th, while low temperature delayed them until May 8th. In warm weather nesting started at once, in cold weather it was delayed a week. The study of this chart is commended to those who insist that temperature has nothing to do with migration or the time of nesting.

Table 2 (p. 216) showing the number of minutes spent off the nest by three females in four nestings is of especial interest. Oven-birds have an exceptionally slow rhythm of incubation and feeding young for a Passerine bird. In 26 full-day records of incubation these birds left the nest from 5 to 13 times, the median

being 8.5 times. No. 9 averaged 7.3 absences, No. 6, 12.2, No. 15, 9.2 in 1935 and only 5.8 in 1936. The length of the periods off average 20 minutes with two of the birds, the temperature averaging 80° F. Eight days' record for No. 15 in 1935 gives an average period off the nest of 16 minutes (temperature 59° F.); ten days' record in 1936 gives 22 minutes (average temperature 63° F.). In analyzing the data with the use of daily average temperatures kindly sent me by Dr. Hann, I found that during the first five days in 1936 the temperature averaged 67.5° F., the average number of absences was 5.8, and their average length 27 minutes; during the last five days the temperature averaged 58.3° F., the average number of absences was again 5.8, but their average length was 16.6 minutes. Thus No. 15 stayed off the nest 16 minutes both years when the temperature averaged 58–59°, but stayed off longer during hotter weather.

Periods on the nest averaged as follows: No. 6, over two hours; No. 9, an hour; No. 15, an hour and a half in 1935, and over two hours and a half, in 1936. The total daylight time spent incubating averaged 86 per cent with No. 9, 73 per cent with No. 6, 85 per cent with No. 15 in 1935 and 86 per cent in 1936.

Records of all-day feedings are not common in the literature; in Table 5 Dr. Hann gives us 32; these are complete records on four nests taken from the itograph. There is a striking increase from the beginning to the end in every case, in three of the nests each day's count being higher than the one preceding. At two of the nests there was a sudden increase on the fifth day. At the nest that contained four Oven-birds and two Cowbirds the feedings ranged from 28 the first day to 160 the last, totalling 666; at the nest with five Oven-birds feedings rose from 27 to 123, totalling 548; at one with two Oven-birds they went from 16 to 67, totalling 304; at one with three Oven-birds they ranged from 20 to 61, totalling 289. These figures are very low in comparison with those for most Passerine birds (except those that feed by regurgitation); Oven-birds make few trips, but bring large loads each time.

Fifty-five per cent of adults survived one year; 31.5 per cent two years. Only one of 68 banded nestlings (a male) returned; he settled three hundred meters from his birthplace. There were two cases of remating two years in succession, two cases of bigamy, and a number of instances where a mated female copulated with neighboring males.

A second set of eggs is started five days after the first is destroyed. Incubation lasts twelve and one-fourth days; fledging eight days. Sometimes the female goes through "motions of feeding when it has no food" to lure young out of the nest or to induce them to follow her. Young are cared for till about thirty days of age.

As to nesting success, 24 females laid 161 eggs; 102 hatched (63.4 per cent), and 70 were fledged (43.5 per cent). Of these 70 fledged young, 39 survived to independence, 24.2 per cent of the 161 eggs, 56 per cent of the fledged young. An average of 1.6 young per female left the woods. Five of the females raised no young. Only one adult (a female) was known to have been killed during the nesting season.

Half of the nests were parasitized by Cowbirds, from one to four eggs being laid in a nest. The female Cowbirds watched the Oven-birds building (one doing so for 22 minutes at a distance of 4.5 to 10 meters); the Oven-birds did not recognize the Cowbirds as enemies. Eggs were laid at dawn. Eggs of the host were taken in the forenoon, but never at the time of laying, in contrast to the Cuckoo as found by Chance; 10 eggs were taken on the day before the Cowbird laid, 10 on the same day, and 3 on the following day. The incubation period was 11.1-11.8 days, .6 of a day less than that of the Oven-bird. The survival rate of 40 eggs was 25 per cent, in contrast to 43.5 per cent of the host.

There are excellent observations on territory, growth and development of the young, behavior of adults and young, and many other points. This paper should be in the possession of every student of life-history; it will well repay careful study. Dr. Stephens has earned our thanks by devoting almost the whole of the September issue of the *Wilson Bulletin* to this notable piece of work.

"The Return of the White Stork in 1937."[5]—The majority of *Ciconia c.*

ciconia reached Germany three to four weeks late; many of these failed to raise young. In one locality where 2.42 young had been raised per pair in 1936, less than one per pair was raised in 1937. Dr. Schüz believes the trouble lay in South Africa; the Storks may have suffered from parasites in flooded areas that killed many and weakened others. There were reports that many died from eating poisoned grasshoppers.

"The East Prussian Stork Population also Decreases in 1937."[6]—In 1936 there was high fecundity, with four and five young fledged in many nests, and an average of 2.5 young raised per pair. In 1937 most of the Storks failed to appear at the usual time; in some localities there was only one fifth of the normal numbers. At a few nests there were three Storks. In May other birds came; fights were staged and eggs and young destroyed. Second layings contained only one and two eggs, while the young suffered from heat, drought, and lack of food. Only 0.7 young were raised per pair.

"Observations on the White-tailed Eagle."[7]—*Haliaetus albicilla* is Germany's largest bird of prey; its food consists of fish, wounded or molting ducks, and large numbers of Coots (*Fulica atra*). The latter show an interesting social reaction when threatened by an Eagle; they all jam together, and the Eagle seems confused and unable to individualize one to capture it. The young Eagles are social, hunting and roosting together; the author once saw as many as ten together. Adults are not unfriendly to one another; in the few places where several nest near together, they may be seen sitting on rocks or piles near one another waiting for prey. The author warns against disturbance of the nesting pairs by photographers. The birds are protected by law.

"The Virginia Rail in Michigan."—Lawrence H. Walkinshaw. 1937. *Auk*. 54:464-475. This study of *Rallus l. limicola* is heavy with sound material on dates of arrival and nesting, incubation period (20 days), hatching, leaving the nest, adjustment of nest to water-level, and descriptions and weights of nests, eggs, and young. It contains relatively little on daily behavior, though there was some observation from a blind, and the scattered details of so unfamiliar a pattern are of rare interest. Such are the episodes of working dead rushes under the eggs to raise them from rising water; the rescue and carrying off by a parent of a newly hatched downy young which had escaped from the nest only to be caught in the weeds; the leaping from the nest of an adult, when a hand was stretched out from the blind, not to flee, but viciously to attack the hand; at least temporary brooding by two adults at one time; and the difficulty of the male in covering the eggs during a rainstorm.—T. T. McC.

"Biological Observations on the Development of the Barn Owl."[8]—A study of feather-development, weight, and numbers of feedings of six young *Tyto alba* in Switzerland. By means of the terragraph it was found that from three to fifteen meals were brought per night, the median of twenty-eight nights being eight. The weight of the young owls increased to a maximum of 360 to 400 grams about the thirtieth day; decreased after that in connection with the growth of the feathers, increased somewhat again, finally decreasing once more with the activity of the young owls, until at two months the birds left the nest, when it reached about 320 grams, an average adult weight. The female does the incubating and broods the young for the first ten to eleven days, while the male provides food.

"Report of the Little Owl Inquiry 1936–37. (Organized by the British Trust for Ornithology.)" Alice Hibbert-Ware. 1937. *British Birds*, 31:162-187. Another example of the coöperative work of British ornithologists. *Athene noctua vidalii* was introduced into England in Northamptonshire and Kent from Europe between 1874 and 1889. By 1900 it had become abundant, having spread over most of England and Wales. "It rapidly became a bird of evil repute and widespread charges were made against it of serious depredations on song birds and game and poultry chicks." The investigation of 2460 pellets, 76 nests,

and 28 gizzards does not substantiate these accusations. The bird is less common now than it was a few years ago even where it is not persecuted. Smaller clutches are found now than thirty years ago, when the average set contained four to five eggs; now it contains three.

"Observations on the Nest Life of the White-backed Woodpecker."[9]—*Dryobates l. leucotos* is a rare bird in the Bavarian Alps. It prefers old, rotted stumps for feeding and for nest-sites. The author suggests that this preference may be one reason for the bird's rarity. The tree containing the nest which he studied was blown over in a storm, and the young were killed. A few days earlier he had watched the nest from noon till night; the two young, which were about five to seven days old, received 27 meals from the male and 17 from the female. The next day he watched from dawn till dark, the first meal being given at 4:41, the last at 7:56; the male brought 46 meals, the female 54. The male spent the night in the hole.

"The Swallows at the Life Sciences Building."—J. Grinnell. 1937. *Condor*, 49:206-210. This building on the campus of the University of California was finished in 1929, but not until 1935 did Swallows make use of it; that year about June 1st twenty pairs of Cliff Swallows (*Petrochelidon albifrons*) appeared and started to nest. In 1936 the first birds came April 16th, starting to build on the southeast corner. On May 12th 128 pairs were established, and on June 4th 161 pairs, as well as 11 pairs of English Sparrows (*Passer domesticus*), which had first appeared on May 27th and had at once started throwing out the eggs and young of the Swallows. On June 12th the first young Swallows were out, 48 days after the first arrival of the adults. It was thought that 95 pairs were successful and that they raised about 190 young. Fifteen nests were occupied by Sparrows. The white throat of the young Swallow appeared to be a "directing device, facilitating quick and accurately aimed delivery of food to the young by the parents." The northwest section of the building was avoided; perhaps the birds needed the sun for quick drying of the mud. Dr. Grinnell states that colonies of Cliff Swallows usually last only two or three years, and he asks whether the reason can be parasites, increasing predation by other birds, or, since young may establish new sites, does each colony last "only so long as the lifetime of a generation of swallows?"

"Breeding Biology of the Dipper (*Cinclus cinclus aquaticus* (Bechst))."[10]—A fascinating tale of two pairs of banded *Cinclus cinclus aquaticus* in Thuringia. Observations were made on the building of the elaborate nest by the female, and each pair was watched all day during the tenth day of incubation and the ninth day of feeding young. On the first date the female of the first pair left the nest 21 times, staying away from 3.5 to 21.5 minutes, averaging 8.5; her periods on the nest ranged from 14 to 82.5 minutes, averaging 32. The other female came off 28 times, staying off from 2 to 14 minutes, averaging 7.8 minutes; she incubated from 5 to 115 minutes at a time, averaging 29.8 minutes. The first bird spent 78.9 per cent of daylight hours on the nest, the second 76.5 per cent. The first male visited the nest 18 times, bringing food to his mate 8 times; the second came 24 times, feeding his mate 13 times.

When it came to feeding young, in both cases the females did the greater share. At the first nest the female had no time to oil her feathers and became wet and bedraggled before the day was over. She fed the three young 196 times, while the male fed 129 times in 960 minutes. She attacked her lazy mate several times, with the result that for a while his zeal increased! These attacks were always accompanied by singing, the female singing 28 times during the day and the male 6 times. This pair was watched again on the twenty-third day of feeding the young; the female fed 217 times, the male 107 times. The male was more indolent than ever, but only once did his mate punish him. The female sang 37 times, the male 15 times; apparently they were in the courtship stage, preparatory for a second brood. The male tried to drive off a pair of Grey Wagtails and Kingfishes, but the female ignored them.

The other pair fed their young on the ninth day 596 times, the female bringing

432 meals. The author considers the difference between the activity of the two pairs as due to better feeding conditions on the second stream, but there probably were more young in the second nest, since five eggs were laid. This female was never aggressive towards her mate; she sang 5 times, he 45 times. She kept the nest scrupulously clean, while he never touched a dropping; he sometimes started to pick one up, but drew back and went to the stream and cleaned his bill just as his mate did after she had really carried off a sac.

The young of the first pair left when 23 days old; one of these when 40 days old was watched as he ran along the bank picking up flower petals and other small objects, none of which proved to be edible. The adults stayed under water usually five to seven seconds at one time; the longest observed period being fifteen seconds. All in all, an admirable study.

Report on the Breeding Biology of the Wood Warbler (*Phylloscopus sibilatrix.*")[11]—A high proportion of unmated males was found in a locality in Mecklenberg, 12 out of 35; these bachelors defended their territories even after their mated neighbors had raised their first broods. Two songs and nine calls of the male are described, four calls of the female, and four of the young. The female builds and incubates, leaving the nest after periods of 45 to 80 minutes on the nest. The male had difficulty in finding the nest during the first day of feeding the young. The author does not state how many hours were spent watching the nest each day, but gives a curve showing average hourly feedings; the male's rate increased from 2.9 the first day to 7.4 the second, 11.2 the fifth; and 19.2 the eighth day, dropping somewhat after that; the female's increased from 2.2 the first day to 5.4 the fifth, 10.6 the seventh, 20.9 the ninth, and 27.3 the eleventh, the day before the six young left.

"Observations on the Nest Life of the Wood Warbler on the Rominter Heide."[12]—Incubation period is 12 days, the female leaving the nest after 23 to 39 minutes, and staying off from 7 to 10 minutes.

"Observations on the Nest Life of the Spotted Flycatcher, *Muscicapa str. striata,* **on the Rominter Heide."**[13]—Another of Dr. Steinfatt's excellent studies. Incubation is by the female and lasts 14 days; periods on the nest lasted 46 to 59 minutes, and off the nest, 5 to 8 minutes. The male occasionally fed her. A nest with four young was watched from 4 A.M. till evening July 15th, all day July 16th, and in the morning of July 17th, during which time the young left. On the 15th—a clear, warm day—237 meals were recorded; on the 16th, which was cloudy and windy, 217 from 2:58 A.M. to 8:31 P.M. Both parents appeared to feed equally. On the 15th the young received food once every four minutes, on the 16th once every five minutes, and on the 17th once every three minutes. The parents tolled the last young bird out of the nest by putting food into its bill and taking it out again.

"Some Domestic Habits of a Pair of Spotted Flycatchers."—Stanley Lewis. 1937. *British Birds,* 31:194–196. Two years in succession a pair nested in an old tea-kettle, raising two broods in it in 1935, but only one in 1936. In 1935 building started on May 21st, and the young left on June 27th; the family returned on July 6th, added some material to the nest while still feeding the young, the female laying the first egg July 8th. This brood was fledged August 7th The next year the cycle lasted from May 19th to July 3d, the first egg not being laid till fourteen days after the start of building in contrast to seven days in 1935. Incubation (performed by the female) lasted 13 days, fledging 13–14 days

"The Breeding Biology of the Grey Wagtail."[14]—A pair of *Motacilla c. cinerea* were watched for six hours on three consecutive days five to seven days after the eggs had been laid. The female incubated from 65 to 74 per cent of the time, the male from 17 to 19 per cent, while the eggs were left uncovered from 10 to 17 per cent of the time. The female incubated at night.

"Nesting of the Bay-breasted Warbler."—Howard L. Mendenhall. 1937. *Auk*, 54:429–439. It is a pity that the desire to take pictures made this a tale of disturbances rather than of systematic watching. Yet the pictures are rare and lovely, and that of the female *Dendroica castanea* shading the young very important. If the time is to come when we can work out the systematics of physiology and of behavior as we now do those of form, such accounts will have to be boiled down to some semblance of comparable pattern. This nest is a rare one, and the observation keen but incomplete and a trifle happen-chance, for the author felt it safer to keep away during most of the incubation period, and squirrels broke up the show at fledging-time. Substantially established for the period of observation are the all-female brooding, the manner and something of the rate of feeding by both sexes (26.4 times an hour by the female, 13 times an hour by the male), certain reactions like "injury-feigning," and sheltering the young from rain and sun by the female. Incubation seems to have begun with early eggs of the five-egg clutch.—T. T. McC.

"The Nesting Life of the Scarlet Finch."[15]—From nests of *Carpodacus e. erythrinus* observed in East Prussia, the incubation period was found to be twelve days, and fledging the same length. One nest was watched all day during incubation: the female left 17 times, staying away 2 to 19 minutes, averaging 9.2; her periods on the nest lasted from 38 to 152 minutes, averaging 48.5 minutes. She incubated 84 per cent of the time during daylight hours. The male fed her occasionally. This was an expression of heightened excitement. She often left the nest in answer to his song or call. The brood of four young were watched all day when one and two days old and when nine and ten days old; on the first date the female made 32 trips with food, the male 6; on the second the female made 18, the male 12 trips. Feeding was by regurgitation, and at each session from 5 to 24 feedings were made.

"Field Notes on the Corsican Citril Finch."—John Armitage. 1937. *British Birds*, 31:98–100. *Carduelis citrinella corsicana* nests in the mountains of Corsica. The parents fly a mile below the nesting-grounds to collect seeds and feed the young by regurgitation at intervals of three quarters of an hour to nearly two hours.

[5] Schüz, E. 1937. Vom Heimzug des Weissen Storchs 1937. *Der Vogelzug*, 8:175–183.
[6] Hornberger, F. 1937. Auch der ostpreussische Storchbestand geht 1937 zurück. *Ornithologische Monatsberichte*, 45:168–169
[7] Wendland, V. 1937. Beobachtungen über den Seeadler. *Beiträge Fortpflanzungsbiologie der Vögel*, 13:175–182; 224–227.
[8] Bussmann, J. 1937. Biologische Beobachtungen über die Entwicklung der Schleiereule. *Arch. suisses d'Ornithologie*, 1(9):370–390.
[9] Jost, F. 1937. Beobachtungen über das Brutleben des Weissrückenspechtes. *Beiträge Fortpflanzungsbiologie der Vögel*, 13:165–174.
[10] Eggebrecht, E. 1937. Brutbiologie der Wasseramsel (*Cinclus cinclus aquaticus* (Bechst.). *Journal für Ornithologie*, 85:636–676.
[11] Treuenfels, H. v. 1937. Beitrag zur Brutbiologie des Waldlaubsängers (*Phylloscopus sibilatrix*). *Journal für Ornithologie*, 85:605–623.
[12] Steinfatt, Otto. 1937. Beobachtungen über das Brutleben des Waldlaubsängers in der Rominter Heide. *Beiträge Fortpflanzungsbiologie der Vögel*, 13:182–189.
[13] Steinfatt, O. 1937. Beobachtungen über das Brutleben des Grauschnäppers, *Muscicapa str. striata* in der Rominter Heide. *Journal für Ornithologie*, 85:624–635.
[14] Vollbrecht, K. 1937. Zur Brutbiologie der Gebirgsbachstelze. *Beiträge Fortpflanzungsbiologie der Vögel*, 13:193–194.
[15] Steinfatt, O. 1937. Das Brutleben des Karmingimpels. *Beiträge Fortpflanzungsbiologie der Vögel*, 13:210–223.

BIRD BEHAVIOR

"Aggressive Display of Birds before a Looking-Glass."—George Brown. 1937. *British Birds*, 31:137–138. In early April a looking-glass placed on the lawn was attacked for hours at a time by a male Pied Wagtail (*Motacilla alba yarrellii*), a male Blackbird (*Turdus m. merula*), and a male Great Tit (*Parus major newtoni*), all three running around behind to find the rival. The females were indifferent. All the males had much black on them and displayed it before the mirror. A male Robin (*Erithacus rubecula melophilus*) paid no attention to it. At the end of April there was little interest, and in May none at all.

"Nesting Habits of the Spotted Sandpiper."—Henry Mousley. 1937. *Auk*, 54:445–451. This corrects the statement of the incubation period of *Actitis macularia* (given in Bent's *Life Histories* as 15 days) to 20 or 21 days, and shows that the male incubated and cared for the young in two instances, but the burden of the paper is support of Dewar's and Friedmann's interpretation of demonstrations of the "injury-feigning" type by the adults as the result of partial incapacitation by nervous shock and confusion. The author simply feels that the variety and extremity of "demented" behavior by the parents when the hidden young were threatened were too extreme to be explicable otherwise. In reviewing the recent discussions of the subject he seems not to have appreciated the diametrically opposite central idea of Jourdain, that such fear is unreasonable and not born out by closer scrutiny of the bird.—T. T. McC.

"Winter Habits of the White-throated Swift."—Gayle Pickwell. 1937. *Condor*, 39:187–188. A flock of *Aëronautes saxatalis* streamed into a niche through a crevice two or three inches wide after sunset at a canyon in California. This bird's "method of going to bed remains as one of the most amazing spectacles of the bird world."

"Observations on Mixed Flocks in Autumn."—George Mayfield. 1937. *Migrant*, 8:47–49. Flocks start to form about September 1st (in Tennessee); they move about one and one-half miles in two hours and then leisurely return to the start. "The permanent residents seem to fix the time, the area to be covered and the rate of travel." "A change to cooler weather often marks the end of one flock and the formation of a new one" around the nucleus of Carolina Chickadees and Tufted Titmice.

STUDY OF MOLT

"The Juvenal Plumage and Post-juvenal Molt of the Chipping Sparrow."—G. M. Sutton. 1937. Occasional Papers of the Museum of Zoology; No. 355. Univ. Michigan. 5p. Another excellent paper by Dr. Sutton on this subject that is so eminently suited to study by means of banding. An eight-day-old *Spizella p. passerina* was raised in captivity and its plumage changes were noted; the post-juvenal molt started when the bird was about thirty days old.

POPULATION STUDIES

"Bird-Lore's First Breeding-Bird Census."—Edited by J. J. Hickey. 1937. *Bird-Lore*, 39 (5):373–386. Thirty censuses from Quebec to California are reported in detail, with data on the ecology of the habitat and number of pairs of each species. In terms of adults per hundred acres the results range from 6 on a new fill on salt marsh to 130 in bog forest, 216 and 276 in pine-hemlock, 536 in second-growth oak-hickory, 760 in an old river bottom (southern Texas), 1240 on an estate in Ohio, and 1680 in a cattail swamp. A splendid beginning on a most important undertaking.

"Breeding Birds of Unglaciated Ohio."—L. E. Hicks. 1937. *Cardinal*, 4 (6):125–141. A discussion of the ecology and breeding bird population in the twenty-two southeastern counties of Ohio. The 130 breeding birds are listed for each county on a scale of ten from "no records" to "extremely abundant." An excellent contribution based on a great deal of careful field work and daily counts of numbers of birds seen.

ECOLOGY

"Some Ecological Aspects of Bird Life."—N. L. Roberts. 1937. *Emu*, 37:48–55. Six instances are given from Australia and one from Africa of the dependence of nesting on rainfall; in one case smaller clutches are reported in drought years, but in the others the birds fail to nest until the coming of rain.

"The Psychological Factor in Bird Distribution."—D. Lack. 1937. *British Birds*, 31:130–136. "In birds each species (instinctively) selects its

habitat, in contradistinction to plants, in which the habitat selects the species." The author believes that in this selection the bird "is probably influenced by the visually prominent, not necessarily the essential, features." He stresses the importance of psychological factors, saying that "they severely complicate all investigations of the factors limiting bird distribution."

"Willow Ptarmigan at the Quebec Zoological Gardens."—J. A. Brassard and Richard Bernard. 1937. *Auk*. 54. 514–515. As an aid to keeping *Lagopus lagopus* in captivity a stomach examination was made of some thirty spring and summer specimens taken in Quebec during the invasion of 1932–33, which is expected to be repeated when a seven-year interval has passed. Ninety per cent of the stomach-contents consisted of twigs, buds, and catkins, in order of quantity, of four species of willow.—T. T. McC.

"On the Changes in the Avifauna of Finland during the Last Decades and the Factors that have Influenced Them."[16]—Since the 70's and 80's southern birds have pushed their ranges northward—Ducks, Coots, Gulls, the Lapwing, Wood Warbler, Tawny Owl, Blackbird, and Blue Tit. At the same time many northern birds have withdrawn, while some species, formerly summer residents, now remain throughout the year—Mallard, Gulls, Hooded Crow, Starling, Chaffinch, Greenfinch, and White Wagtail. The authors have studied the records of the weather bureau for the last hundred years and find a marked increase in mean annual temperature during the last fifty years. Late fall, winter, and spring are considerably warmer at present than from 1830 to 1880.

[16] Siivonen, L. & O. Kalela. 1937. Ueber die Veränderungen in der Vogelfauna Finnlands während der letzten Jahrzehnte und die darauf einwirkenden Faktoren. *Acta Soc. pro Fauna et Flora Fenn. 60*: 606–634.

CONSERVATION

"Thirst on the Land. A Plea for water Conservation for the Benefit of Man and Wild Life."—William Vogt. 1937. National Assoc. Audubon Soc. Circ. 32. 32p. A masterly presentation of the utter folly of drainage, well documented and convincingly written. The chapter-headings discuss: "Why Worry about Marshes and Swamps?" "The Living Swamp." "The Devastation of Our Swamps and Marshes." "Mosquito and 'Malaria' Control through drainage." "What Price Drainage." "Drainage Control a Necessity." The author concludes: "Thus, in essence, the zeal for drainage has ravaged the face of the North American Continent like some form of terrestrial erysipelas. Wild life and vegetation have been killed, and the earth has dried up, only to erode and blow away in dust blizzards that are disastrous to man and beast alike." This pamphlet deserves the widest possible circulation. It may be obtained free from the National Association of Audubon Societies, 1775 Broadway, New York

"Preservation of Birds in California."—J. M. Linsdale. 1937. *Condor*, 39:198–203. A plea for more zeal for bird protection on the part of ornithologists. Since settlement there has been a small decrease in the number of species; some are gone, while others are greatly reduced. "A few species, common ones already, have increased greatly in numbers." Park managers are over-enthusiastic and attract too many visitors.

"Cleveland Nature Trails."—A. B. Williams. The Cleveland Press. 15 cents. Ten additional leaflets have been added to this excellent set of educational pamphlets, the first of which were mentioned in *Bird-Banding* for July, 1937. The new material (costing five cents post-paid) deals with fall and winter, migrating birds, squirrels, mushrooms, "Why the Leaves Fall," "Nature Prepares for Winter," "Winter Bird Companies," "Records in the Snow," etc, and finally a "Spring Bird Timetable," all well and interestingly written and admirably suited to interest children and adults in the out-of-doors. Mr. Omar Ranney, Cleveland Press Nature Editor, and Dr. A. B. Williams, park naturalist of the Metropolitan Park System, have set an example that should be followed all over the country.

BOOKS

Der Brutparasitismus der Kuckucksvögel.—Wolfgang Makatsch. 1937. Leipzig. Quelle & Meyer. 10 RM. 152p. A useful compilation of information on the parasitic Cuckoos. A total of 592 titles are given in the bibliography, yet one at least of the authors mentioned in the text is omitted. There are four sections to the book: parasites outside the Cuciliformes; the Cuculiformes; adaptation of eggs and young to those of the host; and origin of parasitism. An interesting list is given of parasitic birds—the African Indicators and Viduinæ, the South American duck *Heteronetta atricapilla*, the Central American Tyrant *Legatus leucophaius*, and the American Cowbirds, although, curiously enough, *Molothrus ater ater* is not even mentioned! The author thinks that our Mourning Dove is on the road to becoming a parasite on the strength of its sometimes using old nests of other birds and on the report of one case where it ousted a Robin from a new nest.

A great deal of information is given on *Cuculus canorus* and some on other Cuckoos. In several cases the decrease of favored hosts has been reported. As to theories, the author mentions a great many, but inclines to none.

The Birds of America.—By John James Audubon. With an Introduction and Descriptive Text by William Vogt. 1937. Macmillan. N. Y. $12.50. An exciting event for the bird-lovers of America was the appearance of this volume containing reproductions in color of the five hundred plates of Audubon. Although some of the birds are stiff and their colors unnatural, others have a life and beauty and dramatic appeal that is amazing. Mr. Vogt has managed to condense into eight lines beneath each plate a deal of significant material on range, habitat, identification, breeding, etc., with every now and then a trenchant thrust for conservation. In his introduction, also, he gives a maximum of information in minimum space on Audubon, bird-study, and bird-protection. The publishers and editor have done a distinct service to nature-lovers in bringing out this gorgeous book.

The Book of Birds.—2 Vols. Edited by G. Grosvenor and Alexander Wetmore. Washington, D. C. National Geographic Society. $5.00. An excellent popular book on birds, picturing in color, from paintings by Allan Brooks, the majority of species (633) that occur in the United States and Canada; the arrangement of "eastern and western varieties" "side by side" is a decided convenience at times. Besides chapters on the different orders and families, there are articles on encouraging birds around the home, on bird foods, on the Eagle's eyrie by Herrick, on banding by Lincoln and on "Hunting with a Microphone" by A. A. Allen. Two hundred and twenty-eight photographs, mostly by Dr. Allen, add to the interest and value of the volumes.

Birds of the Connecticut Valley in Massachusetts.—Aaron Bagg and S. A. Eliot, Jr. 1937. Northampton, Mass. Hampshire Bookshop. $8.50. This quarto volume of some nine hundred pages is almost entirely devoted to an account of the occurrence of 297 species of birds in three counties in central Massachusetts. The authors have done an immense amount of work "migration-watching" both in spring and fall, and have worked up the history of ornithology in their region in painstaking manner. Field identification is stressed, and sensible observations made on the matter of sanctuaries. Lists are given of migration and hatching dates. Certain northern birds are extending their range to the south—Yellow-bellied Sapsucker, Hermit Thrush, and White-throated Sparrow.

The authors have a thorough knowledge of the occurrence of birds in their region, but they fail to build on this foundation; they do not correlate the distribution of the nesting birds with the ecology of the habitats, nor do they correlate migration with weather. There is some anthropomorphizing in the noting of "scouts" in the case of Cliff Swallows and Purple Martins, a bird that comes early, "makes sure that conditions are unchanged, spends a night in an old nest, departs, and a few days later reappears, gradually assembling companions,"

(page 381) and also in the case of Crows "when a delinquent (a negligent sentry, for example) is 'tried' and condemned" (page 400). It is most surprising to read, "None of our older ornithologists mention the Jay's supposed proclivity to eat the eggs and young of smaller birds, nor have we any positive evidence of this habit," (page 396). One needs only to look at Audubon's plate of the Blue Jay or to read Wilson's account of its habits to see that the contrary was true. In modern times instances have been published of this trait.

Two other features should be mentioned. The sequence of many of the birds has been changed, so one has to consult the index instead of finding the bird by knowing the Check-List order. There is no bibliography, and the text suffers from a most unfortunate lack of references.

Aviculture. A Treatise on the Management of Foreign and British Birds in Captivity.—Jean Delacour. Vol. I. 1936. Hertford, England. Austin. 298p. 20s. 9d. "Aviculture is a scientific pursuit and a source of unending interest and pleasure. It should not be undertaken unless it is intended to give the necessary time and trouble so important to the proper care of birds in captivity." The present volume deals with the Passeriformes as cage-birds. There are short chapters on housing and care, but the main part is taken up with brief descriptions of the appearance, native home, and habits in captivity of an astonishing number of birds. Interesting details are given of the display of the different Birds of Paradise. As to the Greater Bird of Paradise (*Paradisea apoda*), the males are supposed to breed at the age of four or five years, although not attaining full plumage till the age of eight years. Each year every full-plumed bird is slaughtered. Little seems to be known as to details of the parasitic habits of the Whydahs (Viduinæ). A "hand-reared hen" Crested Lark (*Galerida cristata*) "sang as well as any cock." The book is illustrated with twenty-seven plates, nine in color, showing an array of bewilderingly gorgeous birds.

Wanderings of a Bird-Lover in Africa.—Madeline Alston. 1937. London. Witherby. 256p. 8s. 6d. Mrs. Alston's clear and lively descriptions of birds, animals, and countryside reveal South Africa not as the austere wilderness many Americans imagine it, but as a beautiful, varied, and settled land. As to conservation, "the ruthless slaying and slaughtering is bad enough, but the killing of birds has not been wholesale as in South America. And in South Africa the effort to preserve our wild life is growing, and bird sanctuaries are being talked of besides those already proclaimed in Zululand and on the vleis of the Cape." The sanction by the government of the slaughter of big game, under the excuse of the tsetse-fly menace (!), has ceased, and a beginning in its preservation is being made. Mrs. Alston's sympathetic writings should arouse in South Africans a pride in their native wild life and a desire to protect it. The pencil drawings by Moubray Leigh are delightful. A map with itineraries and a list of scientific names would have been helpful to outside readers.—CONSTANCE NICE.

The Bird-Lovers' Book of Verse. Collected by Christina Chapin. 1937. London. Witherby. 188p. 6s. This little book, whose predominantly English authors show more acquaintance with classic literature than with living birds, is illustrated with attractive linotypes by Raphael Nelson.—CONSTANCE NICE.

Check-List of the Birds of the World. Vol. III. James L. Peters. Cambridge, Massachusetts, Harvard University Press. 311p. $3.50. The third volume of this excellent and authoritative check-list deals with the orders Columbiformes and Psittaciformes—the Sandgrouse, Pigeons, and Parrots—142 genera and 1675 forms in all. The plan of Mr. Peters's volumes is to list every valid species and subspecies, with the original quotation, the type locality, and synonyms proposed since the publication of Sharpe's "Hand-List" in 1909. The range of each form, is given, as well as wintering quarters of migratory forms. Mr. Peters deserves the highest praise for his painstaking labors in this important field.

DISEASES OF BIRDS

Reviews by Carlton M. Herman

"Diseases of Birds."[17]—This is the most comprehensive work which has yet been published on the diseases of birds. It is an extensive treatise dealing with the etiology, diagnosis, pathology, and treatment of all the known diseases of the avifauna. Numerous figures illustrate many of the pathological conditions, both microscopic sections and gross material. Although a few errors appear in the text and tables—as might be expected in the first edition of such an undertaking—these are relatively insignificant in view of the comprehensiveness of the work. The material is very well arranged. Each disease is discussed separately and classified according to its etiological agent. The subject matter is completely indexed. The greatest value of the monograph is to be found in the extensive bibliography placed at the conclusion of the discussion of each disease. Although the text is written in Portuguese, the extensiveness of the bibliography serves to introduce those interested to the literature on the subject in many languages.

"Notes on Avian Coccidiosis."[18]—Coccidiosis is a disease caused by Coccidia—one-celled animals (Protozoa)—which live as parasites in the intestines of vertebrates. These Coccidia may cause destruction of the intestinal epithelium, with subsequent loss of appetite, emaciation, droopiness, diarrhea, and finally death due to acute enteritis. Nestlings have been found with severe infections; sometimes (because of these infections) they are pushed from the nests and left to die. Boughton points out that, unless it is brought to our attention in epidemic form, coccidiosis might go unnoticed as a "natural" cause of death for birds in nature.

Two genera of Coccidia occur in birds, *Isospora* and *Eimeria*. Immature spores are discharged from the bird in the fecal material. In the course of several hours or a few days, depending on the coccidian species involved, these spores undergo changes which result in mature forms containing the infective sporozoites. Birds become infected by eating the cysts which contain these sporozoites. The disease may be diagnosed by microscopic examination of a fecal smear. It is emphasized that *Eimeria* occur in the lower orders of Aves, and *Isospora* in the higher. Coccidia have been reported from twelve orders of birds. Boughton concludes that the genus *Isospora* can be considered as a pathogenic parasite of small birds and as such it should be studied with an aim toward treatment and control.

Check-lists of Malaria [19, 20, 21].—These three papers contain a complete list of all the species of *Hæmoproteus*, *Plasmodium*, and *Leucocytozoön*, together with a list of the birds and other animals from which these blood parasites have been reported. There is a complete bibliography of the source of all these records. *Hæmoproteus* is a parasite of birds and reptiles, *Plasmodium* is a parasite of reptiles, birds, and mammals, and *Leucocytozoön* is a parasite which has only been reported from birds. *Hæmoproteus* is listed from 638 species of birds, *Plasmodium* from 236 species, and *Leucocytozoön* from 272 species.

Hippoboscid Flies[22].—Four species of bird-flies are reported to be common on birds in Germany. Swallows (*Hirundo r. rustica* and *Delichon u. urbica*) are common hosts. (The reviewer is aware of no reports of hippoboscid flies from North American swallows, and it is interesting that this group of birds should be heavily infested in Europe.) The genus *Stenepteryx*—a wingless form—is reported to be common on swallows in western Germany but rare in the eastern part of that country. This paper also contains a key to the Hippoboscidæ which occur in Germany.

Nutrition and Place of Egg-laying of Mallophaga[23].—Most Mallophaga obtain their nourishment from feather parts but others may live on dust, skin particles, blood of the host, or even on the eye-fluid. Evidence of cannibalism is also given. These parasites lay their eggs on the feather-shafts and various other parts of the feathers, and in some species the eggs are deposited inside the feather-

shaft. The Mallophaga of mammals usually attach on, feed on, and lay their eggs on the hair of the host. Extensive references are given and the bibliography contains eighty-six citations. A classification of the genera of Mallophaga is also included.

[17] Doencas das Aves. J. Reis and P. Nobrega. 1936. Instituto Biologico, São Paulo, Brazil. 468 pp.

[18] Boughton, D. C. *Auk* (1937) *54:* (4): 500–509.

[19] Coatney, G. R. (1936) "A check-list and host-index of the genus *Haemoproteus.*" *Jour. Parasit. 22* (1): 88–105.

[20] Coatney, G. R. and Roudabush, R. L. (1936) "A catalog and host-index of the genus *Plasmodium.*" *Jour. Parasit. 22* (4): 338–353.

[21] Coatney, G. R. (1937) "A catalog and host-index of the genus *Leucocytozoon.*" *Jour. Parasit. 23* (2): 202–313.

[22] Eichler, W. Wo kommt die Mehlschwalbenlausfliege vor? Nebst Bestimmungsübersicht deutscher lausfliegen. Mitteil. Vereins sachs. Ornith. V, 3. Heft (April 1937).

[23] Eichler, W. Einige Bemerkungen zur Ernährung und Eiablage der Mallophagen. Sitzensberichte Gellsch. natur. Freunde. March 16, 1937.

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